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Figure 2 (Top). Sarcoscypha floccosa, a fungus which grows on rotting sticks. Taken with sliding focusing attachment. 2 X.

Figure 4 (Bottom). Glandular hairs of beard-tongue, Pentstemon sp. These hairs are filled with a mucilagenous substance and break when touched, producing a noticeable stickiness. Taken with sliding focusing attachment. 12 X.

Some Notes Concerning Plant Photography

by E. B. Mains*

AS IN other biological fields, the camera has had increasing employment in botany for recording facts and disseminating knowledge. In the following account, no attempt is made to cover the subject of application of photography for botanical purposes. Rather it is a recording of certain observations and experiences that may be of use to others interested in the field.

The introduction of Kodachrome has made possible the photographing of plants in color with considerable accuracy and at slight expense. With a miniature camera and 35 mm. film, excellent lantern slides can be obtained. Although these are small, they can be projected to a size sufficient for any ordinary purpose without appreciable loss of detail. The ability to show variation in coloration even in the minute details of venation, pubescence, etc., not only adds to the interest aroused but also to the information that can be transmitted.

In photographing plants, as elsewhere, correct exposure is important for accurate reproduction of color. Care must be taken to obtain exposure-meter readings that are made on the subject. This is not difficult in habitat views where there is a mass of flowers. The meter, however, should be brought close to the subject so that it is certain that the surroundings outside the picture are not also included.

In close-ups, to show single plants or single flowers, especially when widely separated or growing singly, the reading will be mostly green foliage or the dark ground. A light colored flower photographed from such a reading will probably be over-exposed to such an extent that it will be white, for it must be remembered that from the position of the camera the meter may cover a much larger area than the camera lens. This is especially true of the light shades of blue. A correction of the reading is necessary. To facilitate this, the reading can be made upon a medium gray cardboard. A flat lighting is usually preferable, for unlike photographs in black and white, color furnishes the necessary contrast. Extremes in lighting at all times should be avoided, if possible, for color values at the extremes will suffer. For this reason, it is frequently difficult

* Received for publication July 7, 1941 from the University Museums, University of Michigan, Ann Arbor, Michigan.

to obtain desirable results in woodlands for the sunlight penetrating through the branches produces spots of bright light and deep shadows.

With plants, one is dealing for the most part with stationary subjects and it is not necessary to reduce the exposure to stop motion other than the vibration caused by wind. Formerly, with the long exposures necessary in color photography, it was necessary to erect windbreaks of canvas or cellophane. This is not necessary with Kodachrome although by present standards it is rated as slow. Exposures of 1/100 second are sufficient to stop the motion caused by light breezes. In sunlight, this can be obtained at f:4. However, for close-ups a greater depth of focus is often desirable than can be obtained at this aperture. To obtain this, exposures of ⅛ to ½ second are often necessary. These are not difficult to obtain even on a windy day. Usually it will be found that lulls occur at fairly regular intervals. During these lulls the plant will become motionless for periods of ⅛ to ½ second or more. With a little experience, these can be picked with considerable certainty. Such exposures require a tripod. However, the use of a tripod should be stressed even for exposures of much less for it must be remembered that images from 35 mm. films will be magnified enormously and should be as sharp as possible.

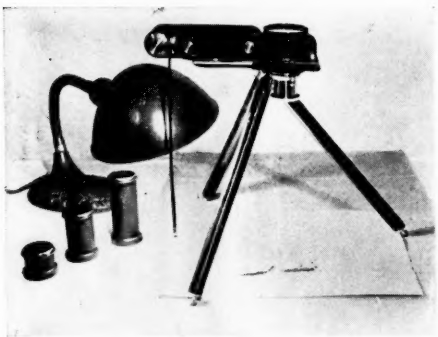


Figure 1. Leica camera with sliding focusing attachment; ground glass above lens. For exposure, the camera slides over until the film is in the position of the ground glass. The tubes of various lengths, alone or in different combination, make possible extension of the lens for greater magnifications.

In photographing plants in their natural habitats, one also encounters difficulties in regard to background. Frequently a desirable specimen has a background into which it blends. It may have an object that distracts the attention from the subject or it may have so many objects that the observer has a feeling of confusion. Another difficulty is that it is often impossible to obtain the desired perspective of a small plant on the ground. This is especially true of fungi. To thoroughly appreciate this, one should try keeping his mind on composition, depth of focus, etc. lying flat on the ground on a hot June day with all the black flies of the area congregating with him under the focusing cloth.

Figure 3. Tulip showing arrangement of pistil and stamens. Taken with sliding focusing attachment. 2 X.

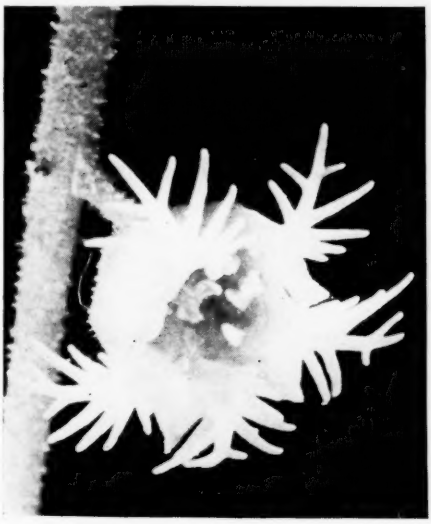


Figure 5. Mitella diphylla bishop's cap, showing the interesting fringed petals. The flowers are very small. Taken with the sliding focusing attachment. 10 X.

The difficulties encountered in close-up studies in the natural habitat make it desirable to bring subjects inside unless the natural surroundings are important. The equipment necessary for most purposes is simple. A table to bring the subject to a convenient height, a series of different colored cardboard backgrounds and two or more lamps on stands that can be easily arranged, are the principal needs. The cardboards afford uniform backgrounds. The colors can be selected according to the subject. Often a color complementary to that of the subject gives striking results. For general purposes, a medium gray has been the most useful. In the case of a flowering plant, the stem is placed in a bottle of water. The plant can be arranged at the desired angle and will keep fresh. If shadows are not desired on the background, it should be placed some distance back. A uniform lighting is obtained by using a photoflood on each side of the camera. It is, of course, necessary to use Kodachrome A or daylight Kodachrome with the proper filter. The tripod should be equipped with a ball and socket type of head to enable photographing from almost any angle. Rubber caps covering the tripod's tips will be found useful to prevent slipping.

If a plain background is not desired, the natural surroundings

may be simulated. This often can be done in such a manner that the plant subject is still emphasized. This, of course, necessitates a thorough knowledge of the plant and its environment, if incongruous elements are to be avoided. Since the study is usually a close-up, only a few "properties" are used or are desirable. These can be brought in with the subject. They can then be kept on hand for other plants with similar surroundings. This method is useful for many of the fungi such as the agarics. A galvanized pan filled with soil, bark covered slabs of various species of trees, or portions of partially rotted branches for backgrounds, partially decayed leaves, mosses, etc., afford convenient settings. Most of these arrangements are also useful in black-and-white photography.

In collecting material for photographing, certain simple precautions are necessary. If material is transported any distance, it must be protected against wilting. For this purpose, a galvanized collecting can, vasculum or a covered basket lined with oil cloth may be used. It is well to wrap small plants or inflorescences in waxed paper. Covering unwrapped material with leafy branchlets or fronds of ferns helps to maintain the necessary humidity. Fungi should be wrapped in waxed paper. Many species of fungi, especially the agarics, are negatively geotropic, and if some species are placed horizontally for a short time, their stems will curve almost at a right angle making the specimen useless for photography. After wrapping in waxed paper, they should be stood upright in cans in the collecting basket. If they cannot be photographed immediately upon returning from the field, they should be stored in a refrigerator or a cool basement. The stems of flowering plants should be recut and placed in water.

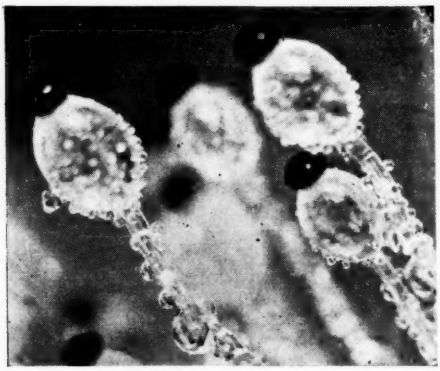


Figure 6. Pilobolus sp. a mold that is photo-tropic and shoots its black sporangia by the bursting of the subsporangial swellings. Taken with camera on the ocular of the microscope, 10 X ocular, 48 mm. objective; illuminated by reflected light from a desk lamp. 20 X.

There are many interesting botanical subjects that are macroscopic yet magnification is necessary if any details are to be discernable. This applies to many of the small species of fungi, to the mosses and liverworts, to the flowers of some of the higher plants, such as many of the trees, and

to floral parts, etc. These subjects are too large for the usual photomicrographic arrangements even with the low powers of the microscope, and the depth of focus is usually not sufficient. The Leica camera with the sliding focusing attachment has been found to be very useful for this class of subjects, (figure 5). This provides a ground glass upon which the image can be focused and the picture composed. A series of tubes of various lengths makes it possible to place the lens at various distances from the film so that magnifications up to four times or more are possible. With small apertures of the lens, considerable depth of focus can be obtained. Since enlargements of 10 times the size of the negatives can be obtained without difficulty, prints having 40 to 50 X magnification are possible.

With the maximum tube length, it is desirable to use the enlarging stand, replacing the lamp housing with an arm on which the camera is attached. The specimen can be placed on a horizontal glass plate supported some distance above the baseboard, thereby eliminating shadows from the background. Lights can be easily arranged to give the desired illumination. A convenient table giving magnifications and exposure factors for various tube lengths is available. The camera with attachment can also be used with the tripod. It can conveniently be carried on extended field trips and makes possible many photographs which ordinarily could be obtained only in the laboratory.

For higher magnifications, the Leica camera with the Micro Ibso attachment gives good results. Its use for mycological subjects has been recently described by Tabor Benedek[1]. The camera can also be placed on the ocular of the microscope. Although this optically is open to criticism, it gives good results at low powers (figure 6), and is useful when the Micro Ibso attachment is not available. It is recommended for its convenience. The microscope is focused. The camera is set at infinity and then placed on the ocular. A simple attachment can be obtained to hold the camera in place. The exposure is made and the camera removed.

This method has been useful to replace sketches in taking notes. Prints can be made on double weight paper of the card size used for notes and can be filed with them. Very little interruption in a study is necessary to make such records. The exposures are easily standardized for different lens combinations. It should be pointed out that with some lens combinations, especially for high magnifications, a flare may be produced and the method, therefore, has restricted usefulness.

[1] Benedek, Tabor, J. Biol. Photo. Assn., 8:73-80, December, 1939.

A Simple and Timesaving Method for Preparation of Lantern Slides

by A. P. Falkenstein, M.D.*

THE making of great numbers of lantern slides is often a very time consuming procedure. Every photographer who has to prepare considerable numbers of lantern slides, would welcome a method which would enable him to finish his task in the shortest time possible and assure uniformly good results. I was confronted with this problem as we demonstrate many lantern slides at our weekly pathological conferences. For this purpose, I had a special working table made which allows the taking of 12 lantern slides in a single exposure. Hence, a description of this table and my working method might be of help to others, who are faced with a similar situation.

The table, (figure 1) which can also be used as a general working table, is about nine feet long. One end supports a vertical board attached on a hinge to which the frames with the negatives can be attached. The other end of the table carries the light source, which is so adjusted that it gives a constant and equal distribution of light. The light source consists of a 10 Watt bulb made of blue transparent glass, which in my experience is best fitted for this purpose and which eliminates excess light. A blinker is put between the socket and the plug, which enables the light to burn in intervals. Each interval is usually somewhat less than one second.

I proceed now in the following way: The negatives are first observed on a light box and divided into several groups, according to the exposure time they require. Then each group is marked with a number, according to the number of blink lights to which each negative will be exposed. Very light negatives require only a short exposure e.g., only one or two blink lights, while others require more e.g., 6 or 10, and in some cases even 15 blink lights. Let us assume we use six negatives, which require four blink exposures and six other negatives which would require 10 of such exposures, I proceed as follows: All negatives are put on the board. The blink light is turned on. After four blink lights, it is turned off and the first set of films is taken away from the board. Following this, the second set of negatives still on the board is now

* Received for publication May 31, 1941 from the Department of Pathology, Mount Sinai Hospital, Chicago, Illinois.

exposed to six more blink lights. Subsequently, the diapositives can be developed together.

It is not difficult to find out how many blink light exposures a negative requires. After some practice, it is very easy to judge the necessary exposure time, when the negative is observed on the light box. For the beginning, I would advise to mark each single negative with its proper number and to group the following negatives accordingly. With this method, I was able to decrease the time spent for the making of lantern slides to one-third of the original time.

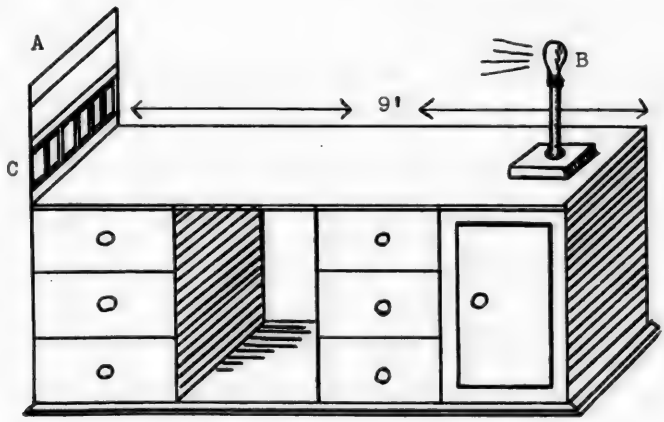


Figure 1. Table for preparation of lantern slides. A. Flexible board on hinges. B. Light source. C. Frames.

An important factor is the proper selection of the diapositive material. We use for our weekly conferences the Eastman Kodak "safety process film" for negatives and diapositives. It is a flexible film, well adapted and easier to handle than glass lantern slides. For projection, the film is put between two glass plates attached to each other along the margin with a narrow strip of adhesive tape. After use, the film is stored away. Lantern slides have the disadvantage that they are bulky and break easily. They also are much slower concerning exposure time and require more time for preparation.

If glass lantern slides are prepared for special occasions, we use Eastman Kodak soft, medium and contrast plates and apply the same method for the contrast lantern slide plate, as it possesses a similar emulsion speed as the Eastman process film. For the medium and soft plates, either the distance between board and light source must be

shortened or the exposure time must be prolonged. However, any diapositive material can be used, if the above mentioned factors are considered and the table is adjusted accordingly. If circumstances require to expose more than 12 negatives at one time, the board must be changed to be able to hold more frames. This can also be achieved if a 5 x 7

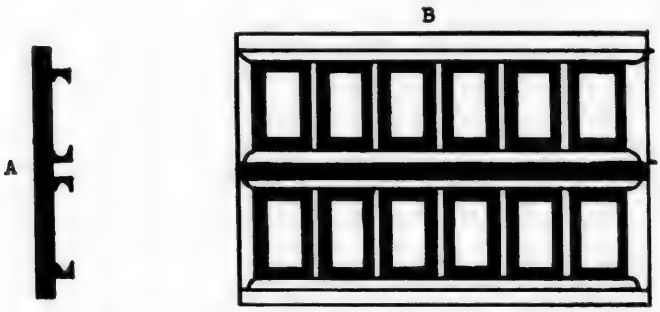


Figure 2. Board 27" x 18". A. Lateral view. B. Front view.

frame is used, which would allow two negatives in one frame. Here, a 5 x 7 inch process film is very useful. It does in no way increase expenses and gives excellent results. I believe that this very inexpensive method will prove extremely helpful and time saving to all who are engaged in this type of work.

FIRST ANNUAL WEST OF THE ROCKIES PHOTOGRAPHIC SALON

The San Francisco Museum of Art will present its First Annual West of the Rockies Photographic Salon from October 29th through November 16th. This exhibition is open to photographers who reside in the states of Washington, Oregon, Idaho, Utah, Nevada, Arizona and California. Three prints in any photographic medium may be submitted. Entry blanks will be forwarded on request. Deliveries must be made October 7th & 8th only. The Jury of Selection will be composed of Edgar Bizzantz, Sonya Noskowiak, Cedric Wright, Imogen Cunningham, and Quinter Olen Gilbert.

Relative Density Method of Measuring Unknown Exposures

by J. D. Brubaker*

THE relative density method of accurately estimating exposure values in photomicrographic, endoscopic, or other complicated photographic set-ups is useful in any case where the illuminated area is too small to be measured by ordinary methods or the optics of the system make it difficult to calculate the proper exposure.

The greatest usefulness of this method is in estimating exposures for Kodachrome in the applications mentioned above. It was developed in connection with the design of endoscopic equipment to check preliminary experimental set-ups and predict with reasonable accuracy the probable lens opening and shutter speed of the camera as well as the light value on the field photographed.

This method does not require precision control of development as in the case of films developed at intervals of several days time.

The basic idea is to take any convenient panchromatic film of about Weston speed 16 or 20 tungsten, and place it in a camera or film-holder. (With cut film or plates, several holders are loaded, one for each exposure). An area of the film is exposed by taking a picture, in the regular way, of a plain medium gray area about 12 by 18 inches or any other convenient size, illuminated by photoflood lamps. The light on the gray area photographed corresponds to the value in foot-candles set opposite the normal (average) arrow of the Weston meter dial. With the film speed on the meter set at 12, the speed of type A Kodachrome, a density will be recorded on the film corresponding to the proper exposure for Kodachrome.

Within moderate limits (say a difference of 6 or 8 Weston), no account need be taken of the difference in the film-speeds of Kodachrome and the black and white film.

In other words, this system compares the light on the film. It will be seen that the light reaching the black and white test film by photographing the gray area is the same value as would be used to perfectly expose the same subject to obtain proper color rendition in Kodachrome.

* Photographic Engineer. Received for publication June 24, 1941 from Evanston, Illinois.

After this first reference light value has been recorded on the film, a series of exposures is made of the unknown light value. The series should be in a progression varying by a factor of two. That is, 1, 2, 4, 8, 16, 32, and so forth. The number of test exposures in the progression series should be sufficient to be sure to include at least one step on each side of the proper value as finally determined. On roll-film, the whole roll is simply developed in any convenient developer giving normal contrast. With cut-film or plates, all exposures should be developed in the same batch under identical conditions. The development time is not critical.

After the developed negatives are fixed, the relative densities are visually compared and an accurate estimate made of the proper exposure. (A better estimate can be made after the films are dry).

It is only necessary to decide if a certain step is lighter or darker than the reference density. This will give results within plus or minus one stop. Half stops can be estimated. Or by making the progression series in steps corresponding to one-half stop light change, 1, 1½, 2¼ etc. (each step 1½ times the preceding one), an accuracy of one-half stop can be attained.

This whole system is based upon the assumption that the particular exposure meter used has been checked on Kodachrome by actually taking Kodachrome films of the gray card and other subjects to check accurately the calibration of the meter.

The exact degree of development of the black and white test film makes little difference, but for ease of comparison a normal contrast is best. The system is almost fool-proof since the author accidentally under-developed one test film to a very low density and yet was able to predict, from the film, the correct exposure within about one-half stop for Kodachrome.

The basic method will give accurate results for average-colored subjects. A variation of one-half to one stop may be necessary for light or dark colored areas since their corresponding density on the test black and white film will, of course, vary from the average gray value when the areas are photographed.

35 mm. X-Ray Slides

by Wilson Footer, M. D.*

THE use of 35 mm. color transparencies for the recording and demonstration of clinical material is vastly increasing the resources for instruction in medical schools.

When color slides are used together with x-rays, the latter are usually presented in viewing boxes at such a distance that detail cannot be seen or are projected as 3¼" x 4" slides which necessitate the use of a separate projector. To simplify the use of x-rays, I record them on 35 mm. film and use them in sequence in the same projector as the color slides.

Method

The essentials for taking any photograph of an x-ray film are a film holder with a source of light behind and a camera in front. For practical purposes, any viewing box can be used, but when recording a large series of x-rays, or ones which are very dense, it is a distinct advantage to have a box in which a photoflood bulb may be used. The quality of some of the 35 mm. films may be improved by using a dodging method such as that advised by Harding[1] but the important details of many films may be recorded without this.

The film I have used is Eastman Microfile which has a Weston rating of 2½. However, if this emulsion rating is used, the negatives will be too dense for projection. Therefore, the film should be considered to have an emulsion speed of 5 Weston to give a less dense negative and one which will project well. The use of a photoelectric exposure meter is essential for uniform results and the reading should be taken from the area of the film containing the material to be illustrated.

A written record of each x-ray film is made when the picture is taken so that pertinent data may be marked later on the mount. This information usually includes subject matter, x-ray film number, patient's name and history number and the date when the original film was taken.

To be able to determine exact measurements at some later time, it is advisable to place a strip of metal which has been notched at one cm. intervals at the bottom of the film. In this way the film may be projected so that the notches coincide exactly with a one cm. scale on the

* Received for publication July 3, 1941 from the Stanford University Hospitals, San Francisco, California.

[1] Harding, F. R. The Reproduction of Radiographs. J. Biol. Photo. Assn. 9:142-148, March, 1941.

projection surface. Then any desired measurements may be made directly from the projected image.

The camera is placed perpendicular to the center of the viewing box at a distance to include all or the desired portion of the x-ray film, and the picture is taken with as small an opening as is practicable. The film may be developed with satisfactory results in any of the usual developers.

The developed film may be mounted in Eastman Ready-Mounts, in homemade cardboard mounts, or in glass. Personally, I prefer to keep my color slides in their Ready-Mounts so they can be used in the Ready-Mount Changer of the projector. Since the changer accommodates only slides of the same thickness as these mounts, I prepare my black and white films in the same manner. If the commercially available mounts are used, a black paper mask will have to be cut to block out any portion of the film which does not completely fill their 23 x 33 mm. opening. An alternative, less expensive but more time consuming, is to cut two inch squares from the proper thickness of cardboard (one-half the thickness of the finished mount) and to cut the exact size opening in each pair designed to hold any particular film. This obviates cutting a separate mask.

Next, Grippit[2] is thinly applied to one surface of both these squares and the film is applied to one of them with the image filling the opening. Then the glued surfaces of the squares, with the film between them, are pressed together and allowed to dry under pressure on a flat surface for about thirty minutes. This particular glue should be used because it does not damage the film even if it should be smudged across it. If it should be, it can be removed after drying a minute or so by gently rubbing with a dry cloth. This is a distinct advantage over other types of glue and collodion which permanently damage the film. Also, should it be desired to remove the film from this holder at a later time for mounting in some other manner, all of the glue can be thus removed and the film is undamaged by it.

It will be noticed that I use the 35 mm. negatives (actually positives of the x-ray negatives) directly for projection without making positives. This has been done to save both time and expense in the preparation of large numbers of slides. There may be some objection to this on the ground that interpretation is more difficult for those accustomed to seeing x-ray negatives. I think this may be refuted in part by reference to the frequent use of reproductions of both positives and negatives of x-rays in many journals. To eliminate this possible objection, direct positive

[2] Manufactured by Harriman-Welts Products Co., Boston, Massachusetts.

film, reversed, may be used, as advised by Milne[3] for reproduction of printed matter for projection.

I find the most convenient projectors to be the Kodaslide No. 1 or No. 2 with Kodaslide Changer which permits rapid projection of up to 50 pictures in prearranged sequence.

By the method described, a complete reference file of x-rays can be made very inexpensively. The film cost, when bought in bulk, is about one cent per picture. Therefore, a series including the normals and pathological variations pertaining to any one of the specialties will cost just a few dollars. In addition, storage space is much less than for the original x-ray films and they may be carried to classes or meetings in the projector case or in a pocket.

SUMMARY

1. A simple, rapid and inexpensive method is presented for the reproduction of x-ray films for projection.
2. These films permit the use of x-ray slides together with Kodachrome transparencies in the same projector.
3. It is suggested that these miniature films be used for building reference files.
4. The cost of film, when bought in bulk, is less than one cent per picture.

[3] Milne, L. J. Rapid Preparation of Direct Positive Filmstrips for Lecture Aids. J. Biol. Photo. Assn. 9:200-202, June, 1941.

LLOYD E. VARDEN ELECTED PSA CHAIRMAN

A Binghamton Technical Section of the Photographic Society of America has been organized in Binghamton, New York. At the organization meeting held on May 28, and attended by 53 members, Lloyd E. Varden, a member of the B.P.A., was elected Chairman of the group. Others elected were: Fred Jayne, Vice-Chairman, Walter Lester, Secretary-Treasurer, and Ira Current and Frank Fiaschette, Members-at-large.

The Binghamton group is composed mainly of technicians and engineers in the photographic industry; although others are expected to increase the scope and strength of the organization.

Automatic Lens-Aperture Control

by R. V. Dent, F.R.P.S.*

THE photography of small objects such as the human eye presents two difficulties: accurate focusing, and the securing of sufficient depth of field to render the required planes sharply in the negative. These difficulties are increased when it is necessary by the nature of the subject, such as a diseased hypersensitive eye, to keep the light available for focusing down to the minimum.

Therefore, it is necessary to focus at full aperture of the lens, and to reduce this aperture for the actual photographic exposure. For this type of work, the reflex type of camera is best, as it is highly desirable that there be the minimum of delay between focusing and making the exposure. The depth of field obtainable, even at small apertures, is shallow, rarely exceeding half an inch for good definition, which means that it requires very little displacement on the part of the subject to spoil the photograph. It is clear that delay between focusing and making the exposure increases the risk of movement on the part of the subject which, however slight, is liable to shift the planes of focus.

To overcome the delay between focusing at full aperture and the obligatory change of aperture, that is, stopping down from say, f:4.5 to f:11 or f:16, that the device herein described was constructed.

Optical laws being immutable, the law that depth of field is dependent upon actual aperture is no exception to the rule. To secure an image of sufficient size to give satisfactory detail and texture, requires a lens of considerable focal length with the penalty of little depth of field. Any attempt to approach the subject too closely introduces further difficulties in the form of still less depth of field and lack of space between patient and the camera. Too little space is bad because it disconcerts the patient to have camera and lights almost touching him, and is bad technique as there is no space for proper lighting. We have found the combination of an R. B. Auto-Graflex, fitted with an eight inch f:4.5 lens, working at f:16 or f:22, on a quarter-plate size film satisfactory for this class of work.

It is imperative to focus at full aperture, for the additional reason that the intensity of illumination must be low to avoid irritating an already hypersensitive eye; it has to be lower than a normal eye can endure,

* Received for publication April 5, 1941 from the Henry Lester Institute of Medical Research, Shanghai, China.

or matters are complicated not only by discomfort on the part of the patient but by watering of the eye.

As already mentioned, movement of the subject is most likely to occur between focusing and photographing owing to the delay while re-setting the aperture. This has proved to be the major difficulty in this class of work, especially when the lens-markings are indicated by such small figures that the various stops can scarcely be read. The result was invariably a delay of several seconds while the lens-hood was removed, stop altered, and lens-hood replaced. As likely as not, the patient moved a fraction of an inch during the process, with the result the focusing had to be repeated. A pair of focusing magnifiers in the hood of the reflex camera is of valuable assistance in the securing of fine definition.

An automatic method of setting the iris diaphragm to any desired stop appeared to be highly desirable, and it was to meet this need that the present system was adopted. It permits focusing at full aperture, and by pressing a side lever which releases an outer ring, the required aperture is secured at once, followed immediately by the exposure. No further failures caused by movement of the subject have occurred since this device was put into service.

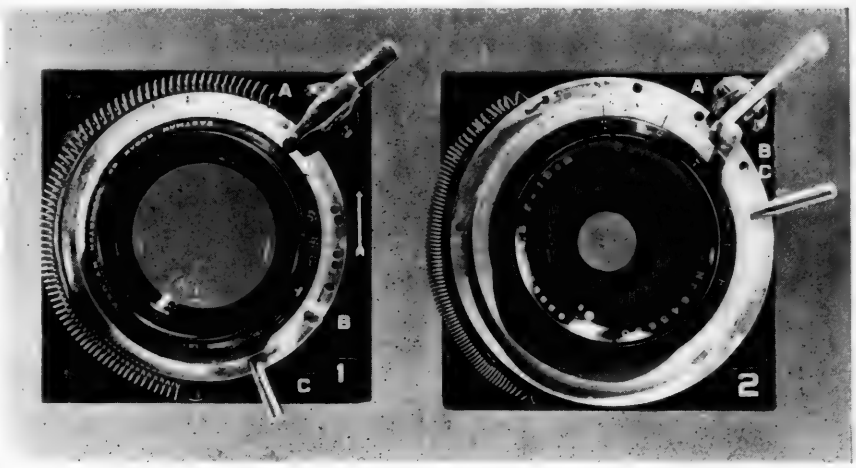


Figure 1 *Figure 2*

The photograph of two lenses thus equipped, figure 1 and 2, should explain the device with but little further description. Each revolving ring controlling the iris has an additional outer ring firmly attached to it by three screws around the circumference. When the lens is set at full

aperture (f:4.5), this outer ring is held in position by a small pin at the tip of a rocking arm. The pin fits into a circular depression sunk at the right point. When this rocking arm is depressed, the pin is lifted and the ring is released; the spring then spins the ring around gently until a vertical rod on the ring comes into contact with the side of the rocking arm, which stops it at the aperture required. This vertical rod, "B" in the figures, screws into any one of several holes around the ring, thus permitting the choice of as many apertures as there are holes. The outer ring on lens No. 2, a Zeiss, is drilled for f number 6.3, 9, 12, and 18, which suffices for our requirements. In the picture, the lens has set itself to f:12. Lens No. 1, a Kodak, is shown fully open. It is, of course, always necessary to decide in advance at what aperture the ring shall stop, but a change can be made rapidly if required.

Needless to say, this system of aperture control can be used for any kind of photography, and it has obvious possibilities on a reflex when working with children. The increased visibility and accuracy of focus when working at full aperture is worth while for subjects nearer than hyperfocal distance, and changing the aperture then becomes the work of an instant.

It is worth pointing out that iris diaphragms are of varying construction, some being stronger than others. The Kodak and Cooke irises are more substantial than the Zeiss. The small grooves in the latter are apt to give trouble if any strain is placed on the leaves of the iris. It is, therefore, desirable that when assembling this device no strain be put on the iris, particularly when equipping a Zeiss lens. Once installed, there will be no trouble as it should be so fitted that the strain on either side is taken up by the pin or the rocking arm, there being none on the iris itself.

Perhaps it may be of interest to mention that so satisfactory has this system been found that semi-automatic control has been fitted to the Cooke lens of a big vertical enlarger and to a Zeiss lens used on a vertical camera. The former lens is identical in type to the lenses illustrated, but no spring has been installed, the turning being done by hand. As we always use the same stop for enlarging (f:11), and focus at full aperture, there is no fussing with the exact setting; a turn of the outer ring and the lens is set at f:11.

The Zeiss lens on the vertical camera being mounted in Compur shutter has no outer ring, but the usual side pointers. To make this type semi-automatic in setting, a piece of brass lined with cloth, slides around the lens. The bottom pointer hits the side of this attachment and stops there, with the result the lens is set at the required aperture.

This is so simple that we wonder we did not think of it before. Figure 3 shows such an "aperture-stop" in place.

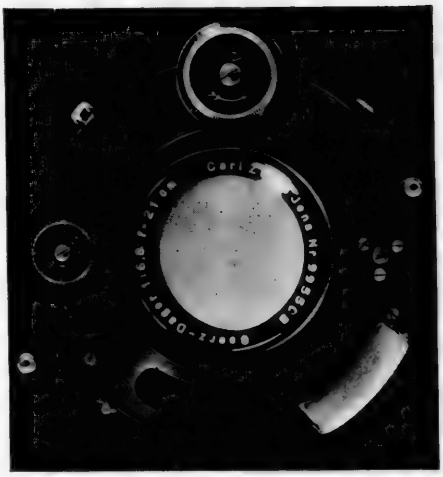


Figure 3. Illustration showing sliding piece of brass which acts as a stop for aperture-setting lever.

We have found that a head-rest attached to an ordinary chair with the patient seated astride or sideways, resting his chin on the head-rest while pressing forward so that the neck is against the rear edge of the head-rest, is both simple and comfortable for the patient and reduces the chances of movement to a minimum. In other words, instead of the patient being seated in the chair in the usual way and resting the back of his head against the head-rest, we lower the head-rest, turn the patient around, and have him use it as a support for face and neck. Even children find no difficulty in taking up this position and holding it. Actual exposures are made by synchronized flash, using the junction box described by the author in the December, 1940 issue of the Journal[1]. It should again be mentioned that under no circumstances should unprotected flash-bulbs be used, for, though it is rare that bulbs explode, the danger is never absent, and on more than one occasion we have had reason to be thankful this important precaution was taken.

Figure 4. Specimen photograph of an eye, showing opaque spot on cornea and distended veins.

The construction of a permanent bench for this class of work has never appealed to the writer, because it restricts work to one type of subject, whereas one may have to record both eyes or the complete mouth and eyes together; it would appear to be a good system when there is a large volume of work in eyes only, which is not the case with us.

[1] Dent, R. V. A. Synchronized-Flash Junction Box. J. Biol. Photo. Assn. 9:73-76 Dec., 1940.

An Integrated Copying System For Half-Tone and Line Originals

by John A. Maurer and James B. Glaze*

UPON starting to do the copying part of the photographic work at the University of Chicago, it was soon evident that a systematic method of copying was highly desirable. Previous workers had prepared a very good copyboard, lights, camera stand, camera, etc., as seen in figure 1. Judging exposure by ground glass brightness to the eye, while quite workable, nevertheless, resulted in a continuous variation in the quality of the work. The use of an exposure meter seemed logical. After having once measured the light, there would be no change in it. The major variables would be the lens opening, camera extension, and originals being copied. Lens openings follow a definite rule. There is, for simple lenses, a definite law for camera extension-exposure effect which does not make it necessary to calculate for each different bellows extension for each separate copy. As for the copy itself, a large part of this will be line drawings and half-tone book illustrations. Both of these are items without gradation; that is, they are either black (in the lines) or white (the background) with no grays. The photography of this type of copy need separate only two tones, namely, black from white.

The system here presented is most useful then for black and white originals. However, most of the principals presented will be very useful in all types of copying and small object photography.

The most critical part of the system is the treatment of halftone book illustrations as line drawings. The work is done carefully to resolve the dot structure of the halftone and to preserve as well as possible the relative dot size. This resolving of the dot structure starts with the choice of camera, copyboard and lens. It ends with the manner in which the printing is done. The use of this technique results in an apparent or actual increase in latitude of making the negative, print or lantern slide. So far as it is practicable to follow, this technique gives a better rendering of the quality and details of the original subject than those methods which do not resolve the dot structure of halftone illustrations.

* Received for publication July 30, 1941 from John A. Maurer, Photographic Department, Loyola University, School of Medicine, and James B. Glaze, Photographic Department, University of Chicago, School of Medicine.

The camera should be one in which the film plane and lens are actually square and true with each other. The copyboard must hold the copy flat, in one plane and exactly parallel with the back of the camera[1]. The board at Chicago is a bookholder from a Rectigraph copying machine (figure 1). The apparatus at Loyola is a perpendicular 24 by 48 inch copyboard surfaced with bulletin board cork. Spring clips are used to hold the copy page against the upright part of the board. For books, the other half rests on a removable shelf. It is also better if the focusing be done by moving the back of the camera rather than the lens, or by moving the camera as a unit. In each case, the camera is a 2D Eastman View. Any similar camera or method that meets the above requirements will be just as satisfactory.

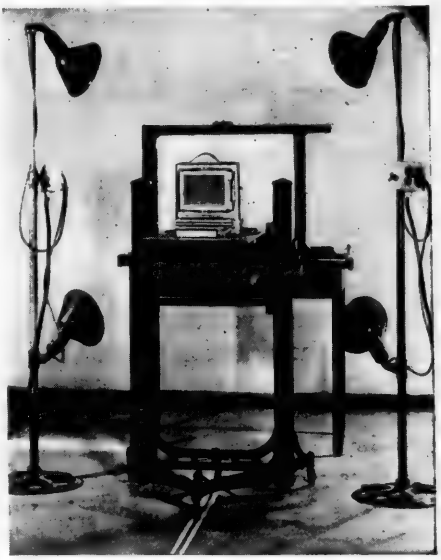


Figure 1. The stand, camera, lights and copyholder used at the University of Chicago.

There should be no stop difference of focus in the lens when using about a 6 X to 10 X magnifying glass on the ground glass. That is, the focus of the lens should not change when the diaphragm or stop opening is changed. In general, those lenses faster than about f:8 or f:6.3 are apt to have this or other errors. This is also a common error in convertible lenses. This feature of stop difference of focus is common in some very fine lenses of speed f:4.5, between the openings f:4.5 and about f:9, but is absent below f:9. The amount present is generally not enough to matter in general photographic work. If not allowed for in the best line copywork, it will take the edge off the quality. In copywork, flatness of field is important. Unless a process lens is used, it may be well to use a longer focus lens, about a six inch to 10 inch for most work on 3¼ x 4¼ negatives.

When copying the same size or larger, if the focus is sharp and lens errors have not interfered, using a strong magnifying glass on the

[1] See Clerc on Photography, page 444; Deville in B.J. of Photography, Dec. 13, 20, and 27 of 1912; the new Eastman pamphlet on Copying.

ground glass, you should be able to see plainly the actual irregularities of inking. Good black ink should have a crisp quality to its black. Poor or thin inking should be quite plain. In examining the negative under a magnifier, you should have the impression of looking at printing through a very low power microscope with the ground glass fuzz removed. A good lens will do this until the finest detail is lost because the resolving power of most film is not high enough. Figure 6a is an enlargement of a negative made with a very good medium speed anastigmat lens that photographers have always praised highly.

When stop difference of focus is present, various things may be observed. With experience, you will observe a certain fuzziness to the image when focusing line or halftone copy with a 6x or higher power magnifying glass. If you look closely, you may realize that there is a certain haze over the image compared to better copying lenses. Should you stop down the lens with the idea of improving the sharpness, you may find instead that the image is less sharp as if you had changed the focus and the dots may seem to change size and quality as they do when passing the point of focus in focusing. In the negative made with stop difference of focus effecting the result, the white dots, which are black in the negative, will appear bigger than they should and with a definite gradation to the edge. Sometimes when focusing at a larger stop than the exposing stop, the small dots will become larger and grayer, have a hole in the center, or they may disappear. In the case of line originals, the effect will be to produce a thinner line with graded density to the edges. These graded edges cause printing difficulties in which the lines and dots seem to disappear or play peek-a-boo. The results of stop difference of focus are mildly shown in figures 6b and 6c for which the conditions were otherwise similar to figure 6a. The lens used for figures 6b and 6c is of high quality and performs well

Figure 2. Halftone dot structure where the dots were 720 to the inch in the copy negative. This is a 150 X enlargement of a negative on H. C. Positive Stock. Two inch lens about f:9 on original.

until used for closeup line copy work of a critical nature. The color corrections are said to be excellent.

There are other lenses which, while they do not have stop difference of focus, do seem to have a little flare or haze over the image. You can never quite get a sharp cut focus and the blacks of the copy always photograph as if gray. On contrast film, the dots may come out a little sharper than you quite expected but the negative will have less contrast than you should have for copy work of line subjects. This is the haze in the image causing a slight exposure on what should be clear areas of the negative. These lenses which are never quite sharp, but without stop difference of focus, include some of the wide angle lenses, and some very fast lenses. Although these lenses are not best for line copy work, they seem to behave quite well for general photographic uses.

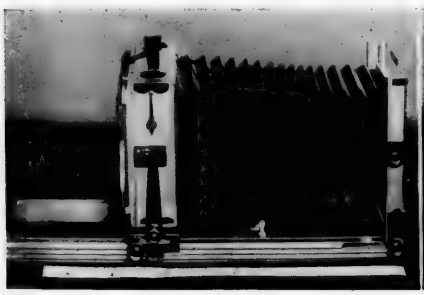


Figure 3. Side View of a camera using rear focusing and an exposure factor scale.

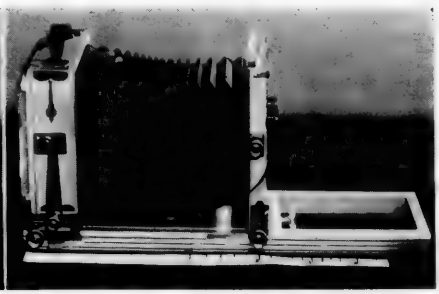


Figure 4. Side view of a camera using front focusing and an exposure factor scale.

To check for flatness of field, focus on flat copy, examining first the focus at the center of the field. Then with your magnifying glass, check the focus at the edge of the field and intermediate points to see if all are equally sharp. When the edge is not sharp, check the diametrically opposite side of the image. If copy, lens and ground glass are not all properly squared up, then the corresponding opposite sides of the ground glass will focus at different lens to ground glass distances. Some fine general purpose anastigmat lenses do not have a perfectly flat field, though it is not a reflection on the general lens quality or design. In one case, a 10 inch f:6.3 lens had only a 1/16 inch change in focal plane when comparing the central focus with a point five inches out from the center. In the case of a nine inch process lens, we could not find such a change in focus by the methods we used. For such a slight difference, you would find about as many photographers who would choose one

lens as the other. For purposes other than enlarging, copying or similar needs, the differences just cited might be meaningless.

Because of the use of the exposure stick to be described later, we recommend checking the focal length of the lens. To do this, find the change in extension of the lens as it is changed from infinity focus, to that for exact one to one reproduction scale. This *change* in extension is equal to the focal length of the lens. The better quality anastigmat lenses will be close to their rated focal length, but RR lenses have been found to be off by 8 to 10 per cent of the indicated focal length. This method is indicated in figures 7a and 7b. It may also be noted that neglecting nodal space in the lens, when copying at one to one reproduction scale, the image object distance is four focal lengths.

We especially recommend checking the lens openings. The marking should be correct, but the authors have found many lenses, and some of very good repute indeed, in which the apparent marked openings were incorrect. In some cases we have found errors that would cause the actual exposure to be 300 per cent of the intended exposure. A 25 per cent to 100 per cent error is not uncommon, while 10 per cent is fairly common and quite satisfactory for most work.

Figure 5. Track arrangement of camera stand.

To check for the diameter of the optical stop of a lens, set the focus of the lens for infinity. Cover the ground glass back of the camera with a black paper. In the center of this paper make a hole with a common pin. Use an ordinary light bulb close to the pinhole while another piece of ground glass is held in front of the opened lens. There will be a dim disc of light on the ground glass in front of the lens. The diameter of this disc of light is the diameter of the aperture in use, figure 8. The f:stops are calculated by dividing the measured focal length by the measured diameters of the apertures. Just a word of warning. Be sure that the measurements are all in the same units, such as inches, or millimeters.

For camera support, an Eastman Semi-Centennial stand is used at both schools as shown in figure 1. Figure 5 represents pictorially a track which has been provided, and guides put on the stand, so that it rolls straight forward and backward in a very convenient way. For centering, the platform of the stand is raised or lowered, and the camera, pressed

against the front stop, may be slid sideways. This makes for time-saving centering.

The next item is calibrating the lens for change in exposure that occurs when focusing closeup. The change in exposure is equal to the square of the ratio of the actual extension to the extension for infinity focus. For many years, the authors measured the apparent extension of the camera for each exposure and then roughly calculated the changed exposure. In copying closeup objects so that they are life size on the ground glass, the proper exposure time will be four times that needed with the same lighting and same subject at such distance from the camera that the extra extension is negligible. For one to one scale with a 10 inch lens, the extra extension would be 10 inches or a total extension of 20 inches. Twenty divided by 10 is two and the square of two is four. The exposure factor is four times that for a distant subject. This can be carried out for all extensions as in Table I. This table can be considered to have its measurements either as inches or centimeters.

TABLE I.

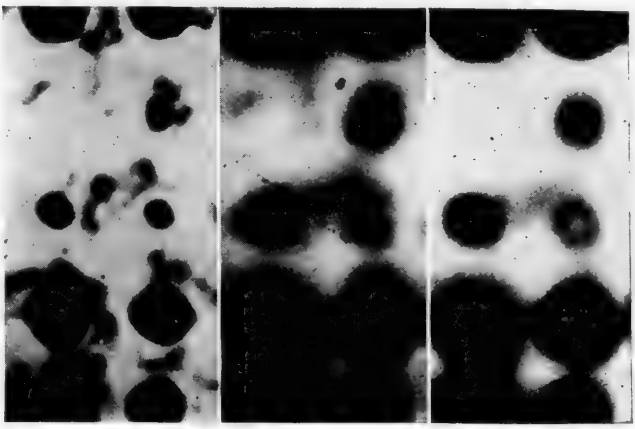
Exposure, extension, and reproduction scale for a lens of focal length 10 units (any system).

Lens Extension	Exposure Factor	Scale of Copy	Lens Extension	Exposure Factor	Scale of Copy
10	1.0	1/oc	16.58	2.75	
10.5	1.1	1/20	17.32	3.00	
10.95	1.2		17.50		3/4
11.0		1/10	18.03	3.25	
11.4	1.3		18.71	3.5	
11.83	1.4		18.75		7/8
12.0		1/5	19.36	3.75	
12.25	1.5		20.0	4.0	1
12.65	1.6		20.62	4.25	
13.04	1.7		21.21	4.5	
13.33	1.78	1/3	21.79	4.75	
13.78	1.9		22.36	5.00	
14.14	2.0		22.91	5.25	
15.0	2.25	1/2	23.45	5.50	
15.81	2.50				

A scale may be drawn for a 10 centimeter lens and photographically converted to a scale for any lens. Such a scale is shown in figure 6c. Photograph the scale. Place the negative in the enlarger and adjust the degree of enlargement so that the distance from factor one to factor four is equal to the focal length of the lens. Mark the projected image onto gummed paper. For view cameras, a stick of convenient size is placed beside the camera, with one end against the same stop as the front end

of the camera. The camera lens is racked all the way forward at all times. Focus precisely to the same size scale. Place factor four opposite the ground glass and fasten the gummed strip to the loose stick. If desired, the gummed strip can be fastened directly to the camera bed. In the case of front focus cameras, the scale is laid out in reverse and the factor four is set opposite an appropriate point on the camera front or lens. The base exposure is calculated as usual and multiplied by the factor indicated on the exposure stick. Figure 3 shows the stick on a rear focus camera with ground glass about even with exposure factor 2.8 X. Figure 4 shows the same camera with a scale for front focusing and the camera front about opposite 2.2 X. This exposure stick is very useful in all types of closeup specimen and macroscopic work.

Correction for extension has been described quite often before, though general application has been slow. David Charles, Commercial Photography, 1928, gives the lens a "name stop". This is the same as the focal length of the lens. Thus a 10 inch lens f:10, four inch lens f:4, and a 16 inch lens f:16. The iris diaphragm is set to the "name stop", which will be one inch in diameter. The working f:No. is the distance in inches between the lens and ground glass. Mr. Kirby, a local demonstrator for Eastman Kodak Co. has developed the same idea in a different manner and applied it to the control of Kodachrome exposures. His stick is calibrated in the Standard Weston Speed series using a series appropriate to Kodachrome.



6a 6b 6c

Figure 6. a) 50 diameter enlargement of 100 line negative using a fairly good lens, (nine inches at f:16). b) 50 diameter enlargement of same original copy, using lens with stop difference of focus, (10 inches at f:7). c) Same as 6b but stopped down to f:16 without refocusing. In each enlargement, note the quality of the gray "splatter ink".

A recent method of exposure calculation is the new Eastman Kodaguide No. 1225 for effective lens aperture in copying and small object

photography. Another method is employed by the engraver who changes the aperture so that the working stop is constant. The Leica Manual has an extensive table for the 50 mm. lens at f:6.3. This includes depth of focus, scale of reproduction, area included, as well as exposure factor. The mathematic formulas are given for various optical problems. American Photography, (January, 1938, pp. 38-42), contains an article by Martin which gives the mathematics involved and the same type of exposure stick as that given here. There have also been articles of a similar type in other photographic literature. Maurer and Glaze have been correcting for extension factor for many years. Mr. Glaze taught and used the principle at least 20 years ago. Mr. Maurer made an exposure stick at the University of Chicago early in 1935. By the use of such exposure controls, copies of line and half-tone originals are made without trial developments. Day after day and month after month, the results are kept usably constant.

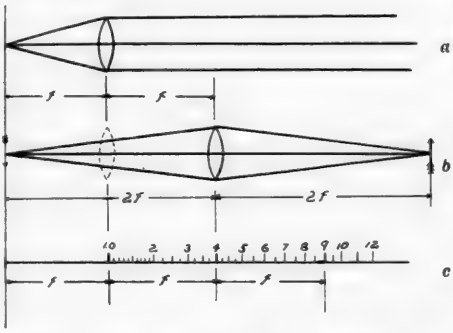


Figure 7. a) Diagram of a simple lens focused on infinity. b) Same lens showing change in extension when focused for one to one copy. c) Related scale giving factors by which to multiply the base exposure when working at other than infinity focus. Drawn to the same scale as 7a and 7b.

The manner of lighting the original copy can also make a difference in results. Obviously, it must be even. A common method is two lights, one at each side of the copy. When two lights are used, they must be pulled back quite a distance to give even light over the area of interest. The simplest method is four lights in plain white matt-surfaced reflectors as shown in figure 1. These lights should be placed on a square, one at each corner of the copy. The sides of the square are twice that of the area to be lighted. The lights are placed in front of the copy at a distance at least equal to the length of the longest side of the copy to be photographed. Thus, to light up a two foot square, the lights should be at the corners of a four foot square and out from the copy two feet. If these lights were point sources, then the light will be even within plus or minus four per cent[2]. In practice, the use of white matt-surfaced reflectors will make but little practical difference in light distribution quality from that of bare bulbs, and with an exposure meter

[2] See Clerc on Photography, page 189. The theoretical calculation referred to the center of the copyboard is from +7% to −1%.

no uneveness of light should be discernible. Of course, the light bulbs should all have the same intensity. Note now that if six lights are used, three on each side, then the light will be stronger in the middle than at the top or bottom. The same effect can be found with tube lights. If tube lights are used, the blocking out of the light from the middle length of the tube may actually increase the area a pair of tubes will light evenly.

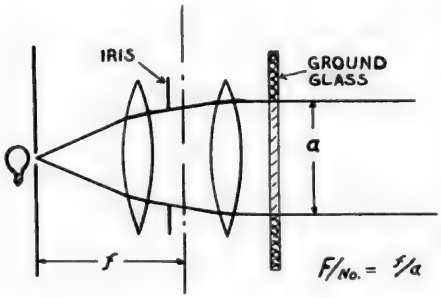


Figure 8. Simple compound lens showing technique of measuring the optical aperture. Note that the diameter of the diaphragm in this case is less than the diameter of the optical aperture. Although this article assumes that the optical aperture has a constant diameter, this is not strictly true when extending the lens in focusing on close subjects. The theoretical extreme for a lens in which the light rays behave just as here drawn and used to greatly enlarge the subject, would call for an additional correction that would double the exposure indicated by the exposure stick given in this article. No attempt has been made elsewhere in this article to develop this additional correction for various lenses and extension conditions.

The light value for estimating the exposure may be read from a white card. The estimated base exposure is multiplied by the factor given by the exposure stick. With the Weston meter and Eastman Process film, try a speed of 2.5 for the arrow position of the calculator. Develop by inspection or time and temperature in a contrast developer. The amount of development recommended by Eastman (five to nine minutes in D.11 at 65°F) results in more density and contrast than necessary for most copies. A somewhat shorter developing time is quite satisfactory. It is best to make a series of exposures at speeds from Weston ½ to Weston 5 and develop all at the same time. Select the best printing negative from this group and base future exposures on the Weston speed used for this best printing negative. A good copy negative has clear sharp lines, with no deposit. The dense parts of the negatives are such that laid on a printed page of a book, the print covered up is barely discernible. This test should be made under very strong light. Greater density is permissible if the lines remain clear and sharp without spreading of halation or irridation. Examine the negatives with a strong magnifying glass, looking for those same qualities previously described under lens testing.

In general, the speeds for all types of films as given by the latest booklets of the film manufacturers are about right. Speed will vary,

though, according to the method of meter use, the particular developer, amount of developing, etc. Reading the meter off a white paper, the subject itself may give an apparent speed difference of five to one when the arrow on the calculator is set to the meter reading in each case. It is possible with film, such as positive stock, to have a speed change of six to one due to variation in developer composition and degree of development. In biological photography, it is often necessary with one and the same film to vary the degree of development widely from ordinary practice. With all these variables then, it is best to run working tests as a final check on working calibrations.

May we repeat again. Halftones in copying should be treated as line copy. For such copy, care in assembling, adjusting and calibrating equipment is most important. Focusing must be done with a good magnifying glass of about 5x to 10x power. The lens or emulsion or both, are often apt to be working to the limit of resolving power. With a good lens, the number of half-tone dots per inch that can be reproduced well is about 1/5 the number of lines per inch that the emulsion will resolve. With care in handling, the number of lines per inch of the half-tone dots can be as great as 1/3 the number of lines per inch that the emulsion is able to resolve. In both cases the number of half-tone dots per inch refers to the number per inch found on the negative. This greatest degree of reduction (1/3 rated lines per inch for the particular emulsion) will give results at least as good as that obtained by working with softer emulsions and treating the original as a continuous tone copy. To show you how small the dots can be, figure 2 is from an enlargement of a negative having 720 dots per inch. The film in this case is H. C. Positive Stock which is one of the higher resolving power emulsions, though not the highest that can be regularly obtained.

As to choice of film. For most black and white line work, a process or contrast process ortho emulsion, or in 35 mm. a positive or fine grain positive stock will be good. Where the greatest contrast or resolving power is required, the emulsions of the Lithographers type will be very useful. In 35 mm., use HC positive stock, the new fine grain positive material, or the very slow fine grained panchromatic stocks such as Micropan, Minipan, or Microfile. For further details on these materials consult the pamphlets and information services of the manufacturers.

Just one word of caution in using the high resolving power films. Do not stop the lens below f:8 to f:11 if the full resolving power of the emulsion is needed. For most other types of films, the limit of resolving power of the film will be at f:16 to f:22. Smaller stops may

be used when great depth of focus is needed or the maximum resolving power is not needed.

For printing line negatives by contact, the authors have certain methods of working that are used to retain all the sharpness put into the negative. First, avoid a printer with opal glass close to the negative. The proper method is a light source of small area at a distance and good close contact between the negative and positive materials. Why the small light source at a distance? Because if contact is not perfect, the silhouette effect of the negative on the positive will give the effect of good contact. For a small light source in the lantern slide printer, we use a 7½ watt frosted bulb. With black tape or a diaphragm, the effective size of the source is made one-half inch square or less. The light is in a printing box at a distance of 10 inches to 15 inches from the slide. The inside of the box is painted a dark non-actinic color. There is no diffusion other than the fact that the light is not quite a point source. For printing continuous tone negatives, a ground glass is used near the negative. No platen is used in either case, just the thumb pressing on the back of the glass slide.

In making lantern slides, slight over exposure can be cleared with a reducer, so that the highlights may be reduced back even to clear glass. In fact, it may even be better to slightly over print the whites to gray and then clear the slide in a reducer. For such reduction, Potassium Ferricyanide will meet most needs. The stock bottle of Ferricyanide is about twenty to twenty-five per cent strength. This is cut according to experience and color of solution. An average strength for use is about one-half per cent to one per cent or about a 50-1 to 20-1 cut of the stock solution. Under some conditions, the desirable strength may vary widely. To use the Ferricyanide solution, a little is poured in a tray and water added to the desired strength. The negative is taken straight from the hypo bath and put in the weak solution of Potassium Ferricyanide. When reduction is sufficient, the negative is rinsed in water to stop the action. It may then be returned to the hypo bath to remove any yellow coloration. If the reducing action stops before enough reduction has occurred, then the hypo carried over in the film has been used up and more must be added, or else the solution is not strong enough in Ferricyanide. (Blue Ferricyanide is exhausted and should be thrown out.)

Make the solution strong enough to give an *even* reduction in a reasonable time. For your first trials, start with a solution that is slightly on the slow side (by estimate) and then strengthen if needed. The factors that cause faster reduction besides strength of reducing solution are: inherent fineness of grain of the emulsion; shorter developing; fine grain developer; non-hardening or slight hardening hypo; short time in

any hardening solutions; type of emulsion in order chloride, bromide, iodide (latter is slowest reducing); basic softness of gelatine; and temperature of solutions. A number of these factors vary from negative to negative or slide to slide in the same job, and hence it is rather difficult to give the optimum strength. The film manufacturers give formulas you may use if you wish. They generally include the hypo in the complete working formula which must be made up fresh from stock solution. Working with a dilute Ferricyanide solution and getting your hypo by the carry-over from the hypo bath probably will allow you to work the reducing solution for more slides, or for a longer period of elapsed time than where the hypo is present in the reducer from the start.

For the making of paper prints from line negatives, the printer should again be similar in optics to the lantern slide printer previously described. Of the general printers on sale, we think of those designed like the Eastman Model 12 Professional Printer, the new Crown Printer of Folman Graflex, or a homemade printer using a clear glass tungsten bulb with a relative concentrated filament and no diffusing system between the negative and light, or else a printing frame with a projection bulb at a distance. Don't move the frame while exposing. There is no objection to printers using diffusing media between the light and negative or to multiple light sources when such printers are used for the printing of continuous tone negatives, especially when dodging must be used. They are really a necessity in such work. But for best line work; no diffusion, small light source, and one to six feet distance between light and negative. These are practical printer requirements.

The printing mask should be very thin or it may cause some lack of sharpness near the edge. The thickness of the mask should be about that of the regular masking paper which is black on one side and orange on the other. Even the thin adjustable masking strips on some printers are thicker than desirable from the standpoint of contact. Where trouble is encountered with these, try putting the negative on top of the masking system instead of under it. Sometimes a pressure cardboard slightly smaller than the opening in the mask will help in a particularly bad case.

Conclusion: Use the best lens you can, one with a flat field, very sharp focus, and no stop difference of focus. Square up the camera, lens and copyboard carefully. Light the copy evenly in a simple manner. Adjust the exposure for bellows extension. Treat half-tones as line subjects and work carefully to resolve the size and shape of the dots. For line subjects, use a contrast emulsion and a contrast developer. Focus with a magnifying glass. Make practical trials to find the emulsion speed under your own actual working conditions. Print with a light that

is concentrated and do not use a diffusion media near the negative you are printing.

The principals presented, if used with care and thought, will give surprisingly good results. If care in focusing and exposure calculating is *not used,* then it will be better *not* to use this system. *Partial control* of this system can at times actually *produce poorer results.* Conscientious following of the principals laid down will at least equal your present results and probably better them with a more uniform product and fewer difficulties.

ELEVENTH ANNUAL BPA CONVENTION

Hotel Buffalo, Buffalo, New York

PROGRAM

WEDNESDAY, SEPTEMBER 10TH

8:00 P.M. Directors' Meeting, Hotel Buffalo.

THURSDAY, SEPTEMBER 11TH

9:00 A.M. Registration. If interested in any trips on Saturday afternoon, obtain this information when registering.

10:00 A.M. President's Address: Leonard Julin, Rochester, Minnesota.

10:30 A.M. Ralph Creer, Veteran's Faculty, Hines, Illinois. *Photography of the Larynx.*

11:00 A.M. Charles Brownell, Eastman Kodak Co., Rochester, N. Y. *Copying an X-ray Film.*

11:30 A.M. Charles Simmons, Buffalo Museum of Science, Buffalo, N. Y. *Difficult Pictures in a Modern Museum.*

Thursday afternoon will be taken over by members of the Research Staff of the Spencer Lens Co., Buffalo, N. Y.

1:30 P.M. A. H. Bennett, Director of Research. *Photographic Lenses.*

2:00 P.M. Dr. Harold Osterberg, Research Physicist. *Photographic Application of Elementary Optics.*

2:30 P.M. Dr. O. Richards, Research Biologist. *Photomicrographic Notes.*

3:00 P.M. Harold Baitz, Photographer. *Photographic Laboratory in Industry.*

6:00 P.M. Dinner at the Buffalo Trap and Field Club. (Compliments of the Spencer Lens Co., Buffalo, N. Y.) Obtain cards at time of registration.

FRIDAY, SEPTEMBER 12TH

8:00 A.M. Association Breakfast.

9:30 A.M. Harris B. Tuttle, Eastman Kodak Co., Rochester, N. Y. *Sound in Medical Motion Pictures.*

10:00 A.M. To be announced.

10:30 A.M. Louis Schmidt, The Rockefeller Institute for Medical Research, New York City. *Proper Methods of Lettering.*

11:00 A.M. Adrian Ter Louw, Eastman Kodak Co., Rochester, N. Y. *News About Color.*

11:30 A.M. Lunch.

12:30 P.M. A trip through the scientific laboratory of the Buffalo Police Department.

2:00 P.M. Detective Sergeant James Barratt, Buffalo Police Dept., Buffalo, N. Y. *Criminological Photography.*

2:30 P.M. F. R. Harding, Children's Hospital, Boston, Mass. *Photographing the Plantar Aspect of the Feet with Weight Bearing.*

3:00 P.M. *What to do and How to do it.* If you have a photographic problem or a method which you can present in five minutes, be prepared to discuss it at this session.

3:30 P.M. Business Meeting.

7:00 P.M. Annual Banquet, Ball Room, Hotel Buffalo.
Toastmaster, Arthur Proetz, M.D., Washington University, St. Louis, Mo., and Speaker, Louis C. Kress, M.D., F.A.C.S., Director of Cancer Control, New York State Dept. of Health, Albany, New York.

SATURDAY, SEPTEMBER 13TH

9:00 A.M. Election of Officers.

9:30 A.M. Robert Young, Haloid Co., Rochester, N. Y. *Wartime Hide and Seek—and the Camera.*

10:00 A.M. Lloyd E. Varden, Agfa Ansco Co., Binghamton, N. Y. *Fluorography.*

10:30 A.M. William Karp, Agent in charge of Buffalo Division, United States Secret Service. *Know Your Money.*

11:00 A.M. Maynard L. Sandell, Eastman Kodak Co., Rochester, N. Y. *The Kodatron.*

11:30 A.M. Roland S. Potter, Defender Photo Supply Co., Rochester, N. Y. *Varigan Enlarging Paper.*

12:00 M. Lunch.

2:00 P.M. Trips:

Niagara Falls
Buffalo Museum of Science
State Institute for the Study of Malignant Diseases.

BOOK REVIEWS

AN INTRODUCTION TO BIOLOGY. J. C. Cross, Ph.D., C.V. Mosby Company, St. Louis, Missouri. 507 pages, 5½ x 7½, 33 illustrations, cloth cover. Price $1.90.

The author summarizes the purpose of his book in the opening paragraph of the preface:

"This book has been written for the special purpose of presenting southern plants and animals to students and teachers of southern high schools. The author believes that the flora and fauna of the South are rich enough to supply good examples for nearly all practical purposes, either for laboratory or for recitation, and he shares the opinion with many biologists that any student will do well to become acquainted with the plants and animals of his homeland. They contribute immensely to his everyday life: they supply much of his food and clothing, the timbers of his house, the beauty of his landscape, and many of the things that make life pleasant. There are other plants and animals that contribute to his more unhappy moments, and he should become acquainted with them also. There is no objection to one's studying the plants of any land, but when a student is surrounded by so many varieties at home, he should begin with those near at hand. A fair knowledge of the southern plants and animals will lead to a better appreciation of those in distant lands whenever occasions to study them arise."

In the introduction, the author discusses what the study of biology includes, how to approach the study of plants and animals, and concludes with a chapter on the microscope.

The simplest animals are then studied, followed by a discussion on plants without seeds, and seed-bearing plants. Chapters on animals with jointed feet and animals with backbones follow. The structure and function in plants and animals concludes the text. An extensive glossary is included.

THE SCIENTIFIC PHOTOGRAPHER. A. S. C. Lawrence, Ph.D. Cambridge: At the University Press; New York. The Macmillan Company. 180 pages, 5 color plates, 81 illustrations; cloth cover, size 5½ x 8½. Price $3.75.

This book sets out to familiarize the reader with the fundamentals of photographic theory and then briefly describes various scientific applications of these principles.

The typography, illustrations and format are excellent. It contains chapters on the bases of photography, the lens and the image, the mechanism of the camera, the making of a picture, developing and printing, color photography and some scientific applications. Appendix I lists formulae for solutions, while Appendix II describes the geometry of image formations.

Recent Trends in Visual Instruction

by George F. Johnson, Ph. D.*

MORE developments to advance visual instruction have occurred during the past fifteen years than during all previous history. These developments include: (1) Compact cameras for stills and movies, having fast lens and selling at nominal prices; (2) Photo-electric exposure meters which eliminate guess-work in correct exposure of film; (3) Photo-flood and photo-flash bulbs and accessories which make indoor photography practical; (4) Fast black and white film which gives satisfactory pictures under adverse light conditions; (5) Color film which yields natural color lantern slides at small expense and more effective motion pictures; and (6) more efficient projection equipment and improved screens.

The effective application of these developments loom today as a foremost challenge to educators. Pictures are rapidly becoming what might be termed a "new language". They provide an easier way to understand new methods and ideas; they make meetings more interesting, and increase attendance; they impress pupils in classrooms so that important points are remembered longer than when words alone are used. This newer emphasis upon pictures and the simplification in means of producing and showing them is likely to revolutionize many existing visual aid programs during the present decade. This can be illustrated by citing our own case.

Our work is extension teaching in agriculture and home economics in Pennsylvania. Our personnel includes 66 county agricultural agents, 21 assistant county agents, 65 home economics extension representatives and 61 subject-matter specialists in 18 fields of farm and home educational endeavor, such as vegetable gardening, dairying, agronomy, nutrition and home management. The county workers have their headquarters in the 66 counties, while the subject-matter specialists' headquarters is at The Pennsylvania State College, and they travel to assist county workers in conducting the extension program through meetings, tours, and demonstrations designed to help solve farm and home problems.

The Old Versus the New in Lantern Slides

How revolutionary recent improvements in visual aids have been in our case can be shown very concretely. For example, the number of

* Specialist in Visual Instruction. Received for publication July 10, 1941 from the Division of Agricultural Extension, The Pennsylvania State College, State College, Pa.

standard sized black and white lantern slides in use decreased from 5,000 in 1935 to fewer than 1500 today, and in their place has come over 20,000 of the new 2″ x 2″ slides mostly in natural color. The significant fact is that we put into use more than *four times as many color slides in four years (1937-1941) as standard sized black and white slides in 20 years (1915-1935).* Even more significant is the fact that a complete equipment change, requiring the adapting of old projectors or the purchase of new projectors, was necessary to effect this change-over in type of slide used. The favorable opinion of our workers on this change is practically unanimous.

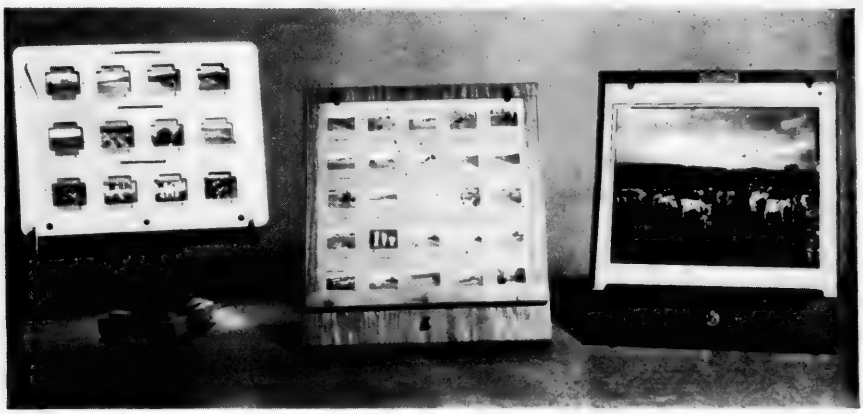


Figure 1. Different types of illuminators from left to right: a) Inexpensive cardboard type holding 12 slides; b) Home-made box holding 25 slides; c) Factory made metal illuminator displaying one 8″ x 10″ transparency or 25 small slides.

A second noteworthy change in type of visual aids used related to the motion picture. In 1935, only four reels of localized 16 mm. motion pictures were available. Motion pictures were secured from outside the State in either 35 mm. or 16 mm. size. Today, 173 reels of our own localized 16 mm. silent movies, at least 50 per cent natural color and relating directly to local subject matter, are used by our workers. During this period, the number of silent 16 mm. projectors has increased from 10 to 60 while the 35 mm. projector has passed into disuse. The number of films borrowed or rented from outside sources has decreased and furthermore there has been little enthusiasm generated for sound films. The number of sound motion picture projectors increased from two to four since 1935 which means that in spite of this small increase, there are 15 times as many silent as sound projectors in use in our organization today.

Screens for showing pictures changed in character completely during this six-year period. Most screens in 1935 were white cloth. These soon proved a very weak link in our program. Color slides did not show up clearly in daytime in rooms that could not be completely darkened. Only one solution could be found and that was to buy the beaded-surface type screen. A few demonstrations were extremely convincing so that today we have 81 glass-beaded screens, 77 in county offices and four in the State College office. Each county has at least one of these screens, and 11 countries have two each. The folding, tripod screen is most popular.

The beaded-surface screen has one limitation in its narrow viewing angle, but this can usually be overcome by special arrangement of seats and screen. The efficiency of the screen in adverse light definitely outweighs its limitations in our special field of teaching. Our insistence upon efficient screens is based upon the conviction that such screens are the cornerstone of effective visual instruction. Do not underestimate the value of a good screen; it makes poor slides or movies look better and the better visual aids look their best.

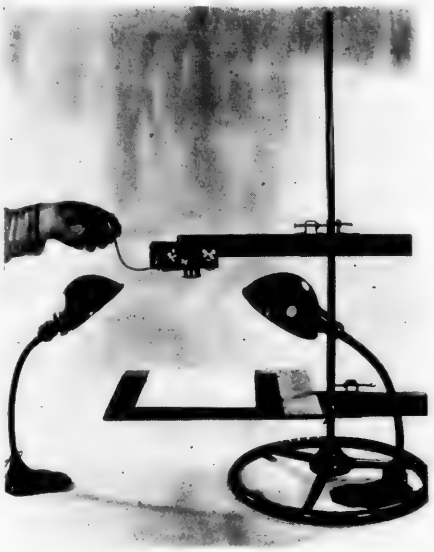


Figure 2. Simple, inexpensive set-up for copying charts or diagrams onto 35 mm. film for 2" x 2" slides.

Miniature Cameras Take Spotlight

Most interesting has been the change in photographic facilities among our workers since 1935. Equipment then included 59 roll film cameras, most of them taking post card size pictures; 30 tripods, one 16 mm. motion picture camera, but no exposure meters and no floodlights. In only 20 of 65 county working units were pictures made into slides. Today, there are 96 miniature cameras (some workers have two), 57 photo-electric exposure meters, 73 tripods, 20 floodlight units, and 14 motion picture cameras (16 mm.) owned by our workers or their extension associations. The result has been that local pictures are used as slides or movies in 62 instead of 20 counties and by most subject-matter specialists. The roll

film camera is passing into disuse and counties which feel the need of large black and white pictures are using the cut film or film pack camera so that one or two exposures can be made and developed without exposing an entire roll of film. The 35 mm. film sized cameras are being used almost exclusively to produce color slides. Making enlargements from 35 mm. black and white negatives has proved disappointing to most of our workers.

What has been the result of all this attention to recent developments in photography and visual aid use? The best answer is probably

Figure 3. The Schuylkill County, Pa. agricultural extension office has almost 400 2" x 2" color slides neatly filed and ready for frequent use. The 100-capacity box in the foreground is used as a carrying case while the 300-capacity boxes remain in the office as files only.

this fact; in 1935, pictorial material was used in less than 25 per cent of our winter meetings for adults; today visual aids are utilized in more than 75 per cent of these meetings! In several counties the percentage exceeds 95. This situation takes on added significance with the knowledge that our organization holds an average of over 100 meetings daily during the winter months with a total attendance of almost 500,000 for these months. Few educational meetings of any general interest are

conducted by our staff today without the aid of well-selected localized visual aids.

One important factor in our plan is that assistance and encouragement is given for workers to produce their own visual aids. The development of the miniature camera, color film and the exposure meter has been a great stimulus in this direction. As we use the miniature camera, it is a "lantern slide" camera since color film is used and when the shutter is clicked, a lantern slide is produced. This so simplified the procedure of producing lantern slides that over 80 of our workers are successfully producing these slides at the rate of 6,000 a year! One county agent has produced over 700 of these slides, and with these he provides a very effective visual aid program on a total equipment inventory of less than $85.00. What about film cost? The cost of film, processing, and binding into slides averages approximately 19 cents per slide. It is important to note that this cost does not include such overhead items as travel, salaries and rent which must be considered in the commercial production of such slides.

2″ x 2″ Slides in Lead

Several facts are apparent as we study the trend in our program. Film strips have never gained a position of more than minor influence because of the popularity of 2″ x 2″ color slides and local color 16 mm. silent motion pictures. Considering only our localized 2″ x 2″ slides and our motion pictures, with a free choice by our workers on which to produce and use, it is becoming increasingly evident that the slide has regained first position as the most practical visual aid in our organization, the motion picture being forced into a position of a supplemental medium of great value but of secondary importance. During 1936, 1937 and 1938, before the 2″ x 2″ color slide came into general use, the motion picture had the spotlight and was highly favored over the old black and white lantern slide.

Any educational service which is so organized that the members of its staff come into frequent contact with their subject matter concretely in the field, should give serious consideration to a program which will enable each worker to become experienced in photography. The person making the best use of visual aids is often the one who has been closely associated with their production. It is not always practical to combine production with use of pictures, but it is so practical where it can be accomplished that it is worth more than passing thought.

The second observation, astonishing to some readers perhaps, is that the sound motion picture has commanded very little attention in our program. While we were adding 50 silent movie projectors to our

equipment between 1935 and 1941, only two sound projectors were purchased. In other words, localized silent color film and slides have so well served our needs, that there has been little demand for the "talkies". We believe, however, that as educational sound films relating directly to our subjects are made available in high-quality color reproductions, they will have a more important place, not as the principal visual medium but as a supplement to our existing highly localized program. They will not likely supplant good local color slides or silent local color movie film for the reason that sound itself in a general picture, no matter how well polished, cannot outweigh in local appeal the actual seeing of scenes and persons familiar to the audience.

Motion Pictures Have a Place

Conclusions regarding the best type of visual aids to use for a particular subject or in a particular situation are difficult to draw. In general, we feel that whether motion pictures or slides are used depends very largely upon the ease and economy with which the medium selected can be made to reflect quickly, timely, and realistically local conditions and circumstances. We use motion pictures for two reasons: (1) Some subjects cannot be clearly presented in any other way; and (2) there are many situations where motion pictures will create more interest, stimulate more discussion and secure more direct action than any other visual medium. The great popularity of 2″ x 2″ lantern slides is found in the fact that they are less expensive, more easily localized and kept up-to-date, and better adapted to systematic teaching of most agricultural and home economics subjects. Combining a 400-foot reel of 16 mm. silent movie film with 20 to 30 2″ x 2″ slides makes a very satisfactory presentation of many agricultural and some home economics subjects. Workers are inclined to use motion pictures in presenting live-stock subjects and method demonstrations, while slides alone or in combination with movies are used for most other subjects.

The Illuminator

One of the newer developments, which we are now using to a limited extent and which we feel has a promising future, is presenting color transparencies either as 2″ x 2″ slides or larger size in so-called illuminators". The idea here is that a natural color slide is something more than a slide to project onto a screen; it is a picture to look at either in natural size or by use of a magnifying glass.

The illuminator idea provided the only way a series of these slides can be viewed and studied as a sequence all at one time. This is a distinct advantage of the illuminator over projected slide or movie film. Simple,

inexpensive exhibits can also be arranged with the illuminator, which is nothing more than a box with an ordinary blue shielded light bulb in the rear and having a glass to diffuse light in front of the box. The color slides or transparencies are placed on this front glass. We expect illuminators to be designed especially for teaching purposes in the near future, thus giving added impetus to natural color slides as visual aids.

Seeing is Believing

In conclusion, reports from our workers using up-to-date visual aids systematically, indicate larger attendance at most meetings, more helpful discussions and more definite decision and determination to act on practices recommended. "I see now what you're talking about," is a common reaction of rural people to the wise use of visual aids.

News From the Trade

Eastman Kodak Company Announces Accessories for Kodak Ektra.

Six accessory items for the new 35mm. Kodak Ektra—including a special flash synchronizer, ground-glass focusing back, view finders for high, low, and right-angle work, a close range-and-view finder, and a special tripod clearance head—are announced by the Eastman Kodak Company, Rochester.

The accessory Close Range and View Finder is intended for use with the 50mm. Kodak Ektar f:1.9 lens at distances from 3½ feet down to 1½ feet; and with the addition of the Kodak Portra 3+ supplementary lens, down to 10½ inches. Its features include a single eyepiece for range and view finder, automatic parallax correction, a vernier scale for distances shorter than 1½ feet, and an internal mask which is slid into place when the Kodak Portra 3+ lens is used. The price is $40. This accessory can also be obtained, on special order, with a specially-calibrated focusing dial for use with the 50mm. Kodak Ektar f:3.5 lens.

The High-Low Angle Finder permits the Kodak Ektra to be used conveniently from waist-level when used on a tripod or other firm support, as well as overhead—thus greatly extending the user's choice of viewpoint. It covers the field of the 50mm. lenses, slips into the universal accessory bracket on top of the Ektra, and will retail at $15.

The Right-Angle Finder for the Kodak Ektra is of particular use in obtaining unposed shots, as well as for shooting in cramped quarters where it is inconvenient to face the subject. Its price is $10.

The Ground Glass Focusing Back for the Ektra possesses several interesting design features, which fit it both for accurate and studied composition of general scenes, and for extremely critical focusing on close-up subjects—such as table-top scenes, medical specimens, and line or tone copy. Similar in shape to the Magazine Back of the Ektra, it incorporates a ground-glass panel of extremely fine texture, a self-erecting magnifier for critical focusing, and a mirror which can be set at a 45-degree angle for reflex-type focusing at various camera positions. The price is $25.

The Ektra Flash Synchronizer is a compact, highly efficient unit especially designed for use with this camera. It attaches to the top of the camera by means of the Ektra's accessory clip, and the tripper unit is simply screwed into the cable release opening of the camera. No other adjustment is required, yet the unit synchronizes for speeds up to and including 1/500 second. The quick-ejection socket and ellipsoidal reflector are arranged to accommodate No. 30 or No. 31 Photoflash lamps. For work in dim light, a small flashlight lamp is included, which when turned on provides illumination for the scales and control dials of the Ektra. The price is $17.50.

The Kodak Tripod Clearance Head for the Ektra is a compact inexpensive unit which raises the camera a short distance above the tripod head. This allows the hinged cover of the Magazine Back to be opened for loading or unloading, or another Magazine Back to be substituted, without removing the camera from the tripod. The price of this unit is $1.25.

News from the Wabash Photolamp Corp.

A new high-powered Superflash bulb primarily designed for professional use has just been announced by the Wabash Photolamp Corp., Brooklyn, N. Y. known as the No. 3X. The new bulb is packed with an exceptionally high-powered light output of 4,500,000 peak lumens that are developed in a broad peak instantaneous flash of 110,000 lumen seconds. A special feature is the introduction of a new type of lens-clear, colorless, safety jacketing that assures 100% light transmission, no absorption, and no objection of any kind for color work.

The extremely high powered peak-light flash that the bulb develops is ideal for use in covering large wide areas. The 3X is in the same synchronization band as the No. 3 and is precision timed for multiple work in black and white or color. List price will be 25c per bulb.

Three New Daylight Superflood Bulbs for Color Use. To meet the critical requirements of color photography, Wabash has announced three

new Daylight Blue Superfloods, called Nos. B1, B2, and B4. These new bulbs are made of a natural daylight blue filter-glass which acts as its own self-filter to bring out the color spectrum of the light to approximate natural daylight, thus eliminating the need for correction filters when taking indoor color pictures with professional daylight type Kodachrome film.

New Infra-red Blackout Superflash bulbs. Wabash also announces a specially designed flash bulb to be known as the Blackout Superflash. The Blackout lamps now make possible for the first time, practical instantaneous photography in total darkness, with infra-red light.

Essentially the Blackout lamp is a hydronalium wire-filled Superflash treated and coated with a specially prepared black infra-red filter which dries hard and cannot be damaged by any mechanical, chemical, or atmospheric condition normally encountered in any part of the United States. This black infra-red coat serves to hold back the visible light produced by the flash. It transmits only the infra-red rays which are invisible to the eye but which register on the infra-red sensitive film in the camera.

In application, the lamp can be used in practically any type of reflector, but the best results have been secured with the special infra-red reflectors that several of the equipment manufacturers have designed in collaboration with Wabash. The new lamp will be identified as Wabash Superflash Blackout, will list at 60c and will be available the latter part of August.

News from E. Leitz

Leitz Slide Cleaner: E. Leitz has been experimenting with various solutions in order to find a suitable medium for cleaning cover glass plates. Such a medium has been developed and is being marketed as the Leitz Slide Cleaner. This product is put up in two ounce bottles and a special applicator with each bottle. The applicator is a pliable, plastic test tube having a stopper made of sponge rubber. A small amount of the slide cleaner is placed in the applicator and when the latter is held with the sponge rubber down, the stopper becomes moistened with the solution. In use, the stopper is swabbed over the surface of the glass plate and the latter is then rubbed dry with a clean cloth.

News from the Winnek Laboratory

Trivision: The advent of Trivision revolutionizes three dimensional photography in that only one picture is made and it may be seen in all its three dimensional splendor without the aid of visible viewing devices. Ordinary photographic films are passed through a lenticulating machine

which impresses an optical surface upon the back of the film. The speed and value of the film remains unchanged. It may be exposed in a regular camera by adding a slit diaphragm to the lens. Films may be made of x-rays or rather the fluorescent screen image of x-rays, or of any photographic subject. Further information may be had from the Douglas F. Winnek Laboratory.

News from Bell and Howell

Filma Slide Master: Bell and Howell has entered the 2 x 2 slide projector field. The Slide Master features a base up projection lamp. By burning the lamp base up, it is claimed that blackening is much reduced. The lamp house is well ventilated and there is no over spill of light into the room. The machine is designed to take 500, 750, or 1000 watt base up lamps. Several different focal length projection lens, anastigmatic, are available.

Association News

Our Exhibit at the A.M.A.

This paragraph should be a photograph. But the shoemaker's children proverbially go without shoes, and the photographer's booth had no picture. We ordered one from the professional photographer who, we thought, would be properly equipped for the job. However, either the angle floored him as much as it did us, or the orders got mixed. No picture was forthcoming. According to the old adage, it should now take us 10,000 words to describe what the picture would have revealed at a glance. However, we will try to condense.

We had seven panels of prints and charts; one apiece for: clinical cases, gross specimens, photomicrography, colonies and cultures, endoscopy, the growth of biological photography, and the field covered by our Journal. All the prints chosen were striking and of good quality, but the captions gave our reasons for thinking some more completely successful than others. Two view boxes displayed 72 standard lantern slides, mostly in color. These slides illustrated good and bad copy work; oral and cervix photography, and showed further examples of the various fields covered by the prints. A desk viewer was available for the 35 mm. slides, of which the largest collection demonstrated the good color results of using flash-bulbs for clinical and operative cases, (when conditions in the operating room permit,) and for autopsy specimens. The

panel-prints were further amplified by albums which showed more detailed pictures of set-ups and emphasized standards for medical photography. We were well supplied with good pictures and were grateful to our members for their cooperation. Although experienced exhibitors advised us to stick to one general theme, we felt that this first exhibit was as much for our own education as for that of our visitors, and we wanted to discover what subjects in medical photography doctors want to discuss of their own accord. We, therefore, left the choice of theme to our visitors, and, insofar as possible, had something of everything on hand by way of illustration.

The results were interesting and are worthy of study by our members. As we expected, many questions were asked about the best sort of equipment, mostly by doctors who were starting from scratch and wanted to do some clinical photography in their offices or hospitals. They wanted their pictures in color for the most part, preferably 35 mm. because of its low cost, but they also wanted to be able to take black-and-white pictures and to make standard lantern slides from them if necessary. This is an equipment-question that was discussed in open session during our Pittsburgh convention, but the Recomar and Maximar type of camera, then thought to be the solution, is no longer generally available. For this reason it seems to be time to bring our concensus of opinion up to date by opening this question for discussion again.

More of our visitors turned out to be photomicrographers than we expected. The great majority of these looked longingly at the 3½ x 4 inch color slides but said that personally they were sticking to 35 mm.

The visitors' questions covered every phase of work. They wanted to know how to get truer color; what caused bluish backgrounds, what caused reddish backgrounds; whether apochromats were a necessity; whether photofloods were advisable, optically; how to gauge exposure and a number of other fundamental questions. It is obvious that the B.P.A. could do medical photography a service by compiling a thoroughgoing, up-to-date discussion of the fundamentals of color photomicrography and printing enough copies so that reprints could be handed out at meetings and exhibits.

The same is true of an article covering endoscopic work. The interest in this field is more general than most of us think. The doctors who use endoscopic instruments want to know at least how complicated the photographic procedure is and how much equipment is necessary. It is impossible to make one answer fit all cases. The most economical procedure for a doctor who is starting from scratch may be a foolish waste for the one who already has a camera and only needs the proper

accessories. However, the information could be arranged in such a way that a doctor would at least know into which classification he fell and what, in general, his own problems entailed.

Another subject that was discussed, not only in our booth but generally throughout the Convention, was the reproduction of large numbers of x-rays on small films. Our interest in x-ray work, as exemplified by the many subscribers to our x-ray competition, ought to lead us before long into a study of the techniques, advantages and limitations of the miniature copy.

And now we come to a complex question which the B.P.A. can perhaps no longer ignore. It was raised by several visitors at our booth. "We want pictures like these," they said, "and we are not equipped to make them. Where can we get them?" The answer that most nearly approaches the truth, of course, is "nowhere". There may be ways of obtaining scattered subjects, but there is no organization for disseminating good work to the limits of its usefulness. I am speaking now particularly of slides for teaching. Motion pictures are in a different category. They are more spectacular and the waste of duplicating them is so much more apparent that some progress has already been made in collecting them. But the cost of duplicating still work is less obvious. The immediate loss in terms of cash is small, and the loss in energy, efficiency and general progress is, like the loss from hidden taxes, so dispersed that any effort to diminish it seems a hunt for trouble.

Institutions with photographic departments, goaded by no particular need, keep their ideas contentedly within their own walls. Their attitude plainly says, "Why should we worry to pool pictures into libraries? When we need any we can make our own." And each of us can, in effect, agree. We have made our own in the past and we can keep on doing it. We can refuse to examine wherein the individual field for each of us lies. You in your workshop and I in mine can work doggedly along to come up, at the day's end, with two pictures that for all practical purposes could not be told apart. There may be no logical reason for them both to exist, but what of it—there is no law which requires us to be reasonable. I have my picture and you have yours, and the fellow without equipment—well, it's too bad, but if he wants the picture he ought to get the equipment.

These are, of course, emergency days. Science classes are crowded and may have to be compressed into shorter and shorter periods. As the pressure increases, teaching aids will be at a premium. Nevertheless, we can—perhaps—go along in the old way and the Association can say it is none of its affair. But to do that, it will have to stuff cotton into the

ears of its exhibit-attendants. For steadily, at intervals, as remorselessly as water dripping on a stone, the question came at Cleveland and is going to come again: "We need pictures like those; where can we get them?"

To get comfortably back to our news report, 168 A.M.A. doctors signed up as being interested in learning more about us. About 10 per cent of these became members immediately. The worth of exhibiting cannot, of course, be gauged by the immediate number of memberships, nor can it be gauged by interest shown in a first exhibit. The amount we are able to learn, the amount we can teach, will only become clear as time goes on and we establish ourselves in the practice of exhibiting at scientific meetings. Those of us who attended our booth in Cleveland felt that our first effort justified the work involved and that if our members will continue to stand behind us, we should exhibit again whenever we can.

We are scheduled for a booth at the Pennsylvania State Medical Meeting in Pittsburgh, October 2-6.

ANNE SHIRAS, *Secretary*
University Office, Magee Hospital
Pittsburgh, Pa.

* * * * *

The Association wishes Major Arthur W. Fuch, associate editor and member of long standing, a happy and successful tenure of service in his capacity as instructor in the Army Medical School.

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LEO C. MASSOPUST,
EDITOR

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Figure 1. Female House Finch.

Color Photography of Birds

by Eliot Porter, M. D.*

OVER a year ago, I described a synchroflash technique for making black and white photographs of birds[1]. The advantages of this method over a dependence on natural light were given. It was shown that with one flash lamp placed two feet from the subject, apertures which normally would admit 1/20 to 1/40 the required light are possible at any given shutter speed. Photographs having great depth of field can be obtained in which the birds are identifiable, are not out of focus or blurred, and in which high aesthetic standards are maintained.

For the past two summers, I have been photographing birds in color[2]. The reasons for attempting color photography were several. In the first place, the identification of many species of birds is entirely dependent on their color. In the second place, it seemed possible to me to make a more faithful record of American birds by color photography than has been accomplished by painting. Since color prints were my aim, the most logical method to use seemed at first to be that embodied in the color camera. With this instrument, separation negatives are made directly from the subject without any intermediate steps, thus eliminating many cumulative errors that might be involved in the making of prints from transparencies. However, after some experimentation and further consideration of the problem, I concluded that this is not the case. Color film may be exposed in any standard view camera having adjustments, not possible in a color camera, which greatly aid obtaining maximum depth of field. Separation negatives should be processed under the most exacting conditions for best results, while these conditions are rarely realizable in the field. Separations from transparencies, on the other hand, need not be made at once but can await the time when a suitable laboratory is available. The last and most serious objection to a color camera is that its filter factors are permanently fixed, probably at some compromise values necessitated by the construction of the optical system or to allow the use of different makes of film. When working with transparencies, the filter factors can be precisely determined experimentally for the film and light source used.

*Received for publication September 8, 1941 from 1077 Sheridan Rd., Hubbard Woods, Illinois.

[1] Porter, Eliot, Making Bird Studies, Photo Technique, March, 1940.

[2] This year's work was made possible by a fellowship granted by the John Simon Guggenheim Memorial Foundation.

Figure 2. Road Runner — Arizona, 1941.

When exposing Eastman Kodachrome film, much greater precision is necessary in determining the exposure and adjusting the positions of the flash lamps than for ordinary film. On Eastman Super-XX sheet film, Weston 64, good exposures are obtained at 1/200 second and the marked relative aperture f:45 with one G.E. No. 21 flash lamp in a reflector placed two feet from the subject.

On the basis of this data, the probable exposure of Eastman Daylight Type Kodachrome, Weston 10, may be calculated. The result is, with all other factors unchanged, a relative aperture in the neighborhood of f:18. Daylight Type Kodachrome requires the use of G.E. No. 21B daylight lamps. The blue lacquer on these bulbs reduces their output by 66 per cent but since for best lighting two lamps should be used, one on either side of the camera, the total output is diminished by only a third, which can be compensated for by placing the reflectors a few inches closer to the subject. It is not safe, however, to depend on this calculation for correct exposures of Kodachrome. The final determination of the exact relative aperture must be made experimentally. The reason for this is that the exposure latitude of black and white film is much greater than that of color film. Thus, for Eastman Super-XX sheet film, the exposure range is approximately 1 to 100. The brightness range of the significant parts of the subject is rarely greater than 1 to 16. Therefore, variations of exposure of six times or 500 per cent are permissible. On the other hand divergencies of more than plus or minus 25 per cent from the correct exposure for Kodachrome will result in unsatisfactory transparencies.

The exposure data which follows is applicable only to the particular apparatus for which it was determined. It can serve merely as a rough

guide for the establishment of the correct exposure for any other equipment. The camera which I use most frequently is a 9 x 12 cm. Linhof equipped with an 18.5 cm. focal length Zeiss Protar lens in a Compur shutter. Two G.E. No. 21B flash lamps in 11 inch, aluminum, Victor reflectors are placed, one on either side of the camera, with their rims 18 to 20 inches from the subject. The lamps are ignited by a 45 volt radio battery. The circuit is closed by the operation of a Kalart Micromatic synchronizer, which in turn is released by a special remote control trigger described elsewhere[3]. The exposure is always made at an 8 mm. aperture and 1/200 second. When photographing small birds, the average bellows extention is 26 cm., therefore, the true relative aperture is approximately f:32. The film is Daylight Type Kodachrome.

The simplicity of the method may give the impression that photographs of birds are easily and quickly made. However, there are many factors, some within the control of the photographer and some not, that contribute to failure. The controlable factors are those pertaining to the equipment; those beyond control, to the subject. Since the conditions are much more exacting for the proper exposure of color than black and white film, a lower percentage of success with the former is to be expected.

In discussing the causes of difficulties, those that involve equipment will be considered first. Of all troubles encountered, synchronizer failure is of major importance. All synchronizers intended for use with foil or wire filled bulbs, are devices for starting shutter action after a sufficient delay, following the closing of an electrical circuit which includes one or

[3] Porter, Eliot, Making Bird Studies, Photo Technique, March, 1940.

Figure 3. Female Eastern Gold Finch — Illinois, 1941.

more flash lamps. It is this delayed shutter action, necessitated by the characteristics of the lamps, which is at the root of most of the difficulties.

The mechanisms of most synchronizers are either mechanical or electro-magnetic. When a mechanical instrument, such as that manufactured by the Kalart Company, is out of synchronization it is generally found, upon testing, that the shutter action is not sufficiently delayed in respect to the time of the flash. Often it is very difficult to increase the delay enough to accomplish perfect adjustment. The same situation prevails in the case of two electro-magnetic instruments with which I have had experience. They are the Heilxand "Sol" and the Mendelsohn Universal synchronizers. But with these, and presumably with all other similar electro-magnetic devices, there is a further complication which makes them even more troublesome than their mechanical counterparts when used for this kind of photography. The action speed of the electro-magnet depends on the current through the coil. Any resistance introduced into the circuit, whether in series or in parallel with the magnet, will change this current and consequently effect the adjustment of the synchronizer. Since flash lamps represent such resistance, the adjustment is not, theoretically, the same for one lamp as for two, and proper synchronization for both black and white and for color film is not at the same time possible. The remote control switch cord, which should be 50 to 100 feet long, is a large resistance, which necessitates using a higher voltage source or one of special design.

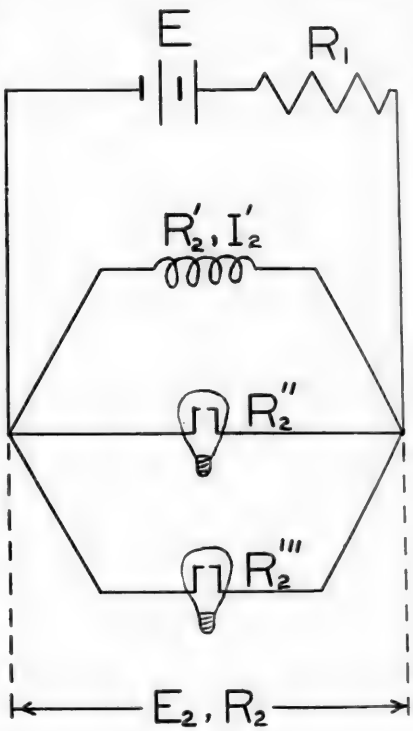


Figure 4.

The Heiland Research Corporation has introduced a booster box containing a 4.5 volt, 80 amp. battery. It is constructed to operate the synchronizer and to ignite one or several lamps by a remote control switch without appreciably influencing the voltage drop and, therefore,

without affecting the synchronizer adjustment. The timing of flash lamps is also influenced by voltage and resistance changes[4].

An increase in voltage across the filament or a decrease in the circuit resistance will decrease the time from closing the circuit to the peak of the flash. These relationships are made clearer by consideration of the following equations derived from Ohm's law. Figure 1 is a diagram of the circuit in which E is a voltage source, R_1 circuit resistance in series with the electro-magnet, R_2 the resistance of the electro-magnet, R'_2, and two flash lamps, R''_2 and R'''_2, in parallel with it. E_2 is the voltage across the lamps and the magnet. I'_2 is the current through the magnet coil.

$$I'_2 = \frac{E}{R'_2}\left[\frac{R_2}{R_1 + R_2}\right] \qquad (1)$$

$$E_2 = E\left[\frac{R_2}{R_1 + R_2}\right] \qquad (2)$$

From equation 1, we see that increasing R_1 as by adding a remote control switch decreases I'_2 and, therefore, makes necessary a readjustment of the synchronizer. A decrease in R_2 by increasing the number of lamps in parallel also decreases I'_2. Equation 2 shows us that the voltage across the lamp filaments is affected in a similar way by changes in R_1 and R_2. With mechanical synchronizers, the voltage source is used solely for igniting the lamps and, therefore, is not subject to excessive loads. By using a high voltage battery, they will operate satisfactorily for a long time. Finally, synchronizers which attach to the shutter through the cable release opening have another disadvantage. Since they are not rigidly fastened but are held in place only by a short nipple or tapered thread, the angle at which the plunger enters the shutter is subject to some variation. The adjustment of the synchronizer for many shutters depends to a large extent upon this angle. Therefore, an adjustment which is perfect for one position of the camera is imperfect for another. Tilting the camera up or down or extending the bellows may alter the synchronization by displacing the center of gravity of the synchronizer from its position at which the adjustments were made. It is advisable to hold such a synchronizer in one position as rigidly as possible by means of a clamp or spring.

The camera shutter is another source of failure in making either black and white or color photographs. Dirt or badly worn parts seriously affect the mechanism of the action so that its performance becomes erratic or is completely thrown out of synchronization with the flash lamps.

[4] Forsythe, W. E., and Easley, M. A., Characteristics of Photoflash Lamps. Photo Technique, May, 1940.

It is obvious that in any kind of photography, best results cannot be obtained with a shutter which is not clean and in good working order.

The flash lamps also are occasionally responsible for faulty exposure. Although they generally perform with great uniformity, lamps are infrequently encountered which do not ignite at a low voltage but one well above the limit specified by the manufacturer. For this reason, I prefer to use a voltage considerably higher than the minimum recommended. When photographing with ordinary film, if a lamp does not ignite, the film can be used again since the exposure due to natural light is too slight to be effective. However, with Kodachrome, when only one of two lamps ignites, the film is sufficiently exposed to be ruined. Another infrequent fault of the G.E. No. 21 lamps is incomplete combustion of the foil, pieces of which are left adhering to the inside of the glass after ignition. These pieces act as screens cutting down the full effectiveness of the flash. Altogether there are about one per cent of these faulty bulbs.

Variations in color rendering in Kodachrome, which has been correctly exposed, occasionally occurs, due possibly to differences between different lots of the film, to slight changes in the processing conditions, or to variations in the blue lacquer on the No. 21B lamps. Thus, some Daylight Type films, all of which were exposed identically on the same day to the same subject, may be distinctly bluer than others. These variations are generally not very noticeable. However, when Type B Kodachrome is used, faulty color rendering is more serious. The use of Type B film has not up to this point been mentioned because of special considerations involved. It will now be discussed.

Type B Kodachrome, which is balanced for a color temperature of 3200° K, may be used for making synchroflash photographs of small subjects close to the camera, even though they are in bright sunlight, without danger of faulty color rendering on this account. In the instruction booklet for Kodachrome Professional Films packed with each box of Kodachrome, is given an exposure table for synchroflash photography. For exposures at 1/200 second with one G.E. Mazda Photoflash Lamp No. 21 (clear bulb), the guide number 45 is given. With a lamp-to-subject distance of two feet, the relative aperture is approximately f:22. I have found empirically that for my apparatus, using two lamps 20 inches from the subject, a marked relative aperture of f:22 or taking the bellows extension into account, a true relative aperture of f:32 gives correct exposure.

Let us now consider the exposure of Type B film to subjects in bright sunlight. The brightness of a colored object such as green leaves

in noon summer sun is about 200 candles per square foot. Therefore, Type B Kodachrome, Weston speed 6, requires the relative aperture f:2.8 at a shutter speed of 1/200 second. Since in practice exposures are made at f:32, a relative aperture which admits only 0.77 per cent as much light as the larger aperture, it is apparent that the film will not be appreciably affected by sunlight. To express this relationship in other terms, the brightness of an object for correct exposure of this film at f:32 and 1/200 second must be approximately 26,000 candles per square foot.

It is now clear that any faulty color rendering which occurs in Type B Kodachrome used for synchroflash photography of birds is not due to the admixture of sunlight with artificial light. There are, however, other obvious causes of poor color. The Kodachrome instruction booklet specifically recommends the use of the Wratten No. 2A filter with Type B film and G.E. Mazda Photoflash Lamp No. 21. This recommendation is also made by the General Electric Company and, as far as I know, was never changed during the time when the General Electric Company was covering its lamps with a yellow lacquer, the presence of which never served any useful purpose. Type B film exposed through the 2A filter with these lamps was much too yellow, without the filter much too blue. When questioned directly, the Eastman Kodak Company admitted that the 2A filter was not correct and recommended as a compromise the CC-15 filter which transmits slightly too much violet light. Recently the General Electric Company has changed the lacquer so that the 2A filter gives much more nearly the right color compensation, but still it is not correct. The same subject photographed on both types of film is quite differently rendered. On the basis of subjective judgment, the rendering by Daylight Type film seems the best. It is to be hoped that the Eastman Kodak Company and the General Electric Company will in the future adopt a policy in regard to such recommendations which will not mislead their customers.

We now come to the consideration of those factors pertaining to the subject which contribute to failure. The most important of these is motion of the birds. Even though the photographs are taken at 1/200 second, it is necessary to be very careful to make exposures only when the birds are not moving, otherwise they will be blurred and fine detail will be lost. Regard should also be given to the position of the birds in relation to the field of the camera. If this factor is neglected, the photographs obtained will not show the birds to best advantage and the composition will be poor. It is sometimes impossible to get good pictures of a

particular bird because it will not come to its nest from the most favorable direction.

Bad weather also interferes with bird photography. Not only does rain make picture taking almost impossible but wind spoils many exposures because of foliage motion, the bird's feathers or even the whole subject. Finally, many bird's nests are plundered before they can be photographed.

There are two lines of probable future development that promise solutions of many of the above discussed difficulties of synchroflash photography. First, there is the recent introduction of the General Electric SM flash lamps[5], which, having a much shorter ignition time lag, greatly simplify the problem of synchronization. Though their light output is much less than the foil filled lamps, their small size makes possible the use of more efficient reflectors. Also since they burn faster, a larger percentage of their output is used at high shutter speeds. Second, development of the Edgerton high speed strobotron flash unit in the direction of greater light output and more compact units may eventually do away with all failures resulting from motion.

The Eastman Kodak Company has just announced a portable Kodatron unit, which, when used with a special film called Kodatron Panchromatic, permits exposures of small subjects at the smallest apertures. The color temperature of the flash tubes is said to be 5600°K or very nearly that for which Daylight Type Kodachrome is balanced. The correct aperture for exposing Kodachrome will have to be determined empirically. There seems little doubt that high speed photography with artificial light will assume ever greater importance in many photographic fields. Nature photographers should not neglect these innovations.

MANAGEMENT OF CICATRICAL STRICTURE OF ESOPHAGUS*

E. H. INGERSOLL — (400 feet, color, silent)

This film depicts principally the treatment of stricture of the esophagus; but there is also included a scene showing the treatment of bronchiectasis by blowing sulphanilamide into the bronchi with the aid of the bronchoscope. The esophageal strictures are treated by the passage of sounds guided by threads. In the most severe case the thread is drawn through a gastrotomy opening; in the other cases the thread is swallowed and permitted to anchor itself in the coils of the intestine. The photography is excellent with clear, explanatory legends. The film should be of value in the teaching of surgery.

ELIOT R. CLARK.

[5] Mohler, Don J., The New SM Flashlamp, Photo Technique, April, 1941.

* Reprinted in part with permission from the Anatomical Record. Reviews of Approved Films in Anatomy and Biology. Vol. 80, No. 4, August, 1941.

Fluorography*

by Lloyd E. Varden†

Definition

Fluorography is the process of recording, by use of an optical system and light-sensitive film, an image formed upon a fluorescent screen, either by a differentially absorbed beam of radiant energy (usually x-rays) or by a stream of directed electrically charged particles. The process, then, includes the photography of fluoroscopic images, as in medical x-ray examination, the photography of television images, cathode ray oscillograph patterns, etc.

The fluorographic process as we now know it has been referred to in literature by various names and one is cautioned to familiarize himself with the most common terms should he attempt a literature search in the field. The most frequently occuring names for fluorography are given in Table I below:

TABLE I

Names Used in Literature to Describe Process Now Known as Fluorography

Indirect radiography	Fluororadiography
Fluoroscopic screen photography	Microradiography
Fluorophotography	Miniature radiography
Roentgen photography	Photofluoroscopy

Historical

The photography of the fluoroscopic screen image followed soon after the discovery of x-rays by Roentgen in 1895. Methods were described in 1896 by Battelli and Garbasso[1], J. S. MacKay[2] and Bleyer[3]. Other papers appeared in 1897 by Porcher[4] and J. MacIntyre[5]. In the paper by Porcher, the opinion was expressed that the results obtained by photographing the screen image were inferior to the contact radiographic method, and this opinion seemed to be the expression of most

* Abstracted from paper on subject of same title given at the Annual Convention of the Biological Photographic Association, Buffalo, New York, September 13, 1941.

† Agfa Ansco, Binghamton, New York.

[1] Battelli, A. and Garbasso, A., Sopra i raggi del Roentgen, Il Nuovo Cimento, Vol. 4, p. 40, 1896.

[2] MacKay, J. S., The New Art of Radiography, Electrician, Vol. 36, p. 668, March 18, 1896.

[3] Bleyer, J. M., On the Bleyer Photo-fluoroscope, Electrical Engineer, New York, Vol. 22, p. 10, July 1, 1896.

[4] Porcher, Photo. de l'image fluoroscopique, Compt. rend. Acad. d sc., p. 408, 1897.

[5] Mac Intyre, J., X-Ray Records for the Cinematograph, Archives of Skiagraphy, Vol. 1, No. 4, April, 1897.

radiologists of the day for fluoroscreen photography immediately dropped out of favor.

Koehler in 1907[6] anticipated the promising future for fluorescent image photography and in 1909, he and Bielsalski described a practical procedure[7]. In 1911, Caldwell[8] published his important paper outlining practically all of the essential principles concerning the application of fluorography. Many others contributed to the early history of the subject. It is doubtful if results were very acceptable, however, for it was not until more efficient fluoroscopic screens became available, until lenses of wide aperture were manufactured generally and until very high speed emulsions were discovered that the recorded images were really of value.

Applications

Although fluorography includes the photography of all types of fluorescent screen images, the widest and most important application is in medical radiography. In this field, fluorography finds two distinct applications, e.i., for single and serial exposures. In serial fluorography, the successive exposures can be made sufficiently rapid to produce so-called x-ray motion pictures[9]. This branch is known as cinefluorography.

Single exposures are made for purposes of record or diagnosis, or both. For group studies of large populations, as in thoracic surveys, fluorography represents a distinct advantage over contact radiography, especially from an economy standpoint. This branch is known as collective fluorography and the individual records are called fluorograms and sometimes fluorographs.

The reliability of fluorography in medical diagnosis is discussed profusely in literature. The comments made by Schopper[10] seem to represent the general opinion in Germany and those made by Hirsch[11] are representative of the feeling toward fluorography in this country.

M. de Abreu[12] has done the greatest amount of work in connection with collective radiography. He has been instrumental in establishing numerous fluorographic outfits in South America and indirectly is re-

[6] Koehler, Kinematographische Roentgenvorfuehrungen normaler und pathologischer Atmung, Fort. a. d. Geb. d. Roentgenstrahlen, Vol. 11, p. 292, 1907.

[7] Bielsalski and Koehler, Die ersten Versuche mit indirekter Methode, Internat. Phot. Dresden, 1909.

[8] Caldwell, E. W., Photo. of the fluorescent screen for Roentgen kinematography and other purposes, Am. Quart, Roent. Vol. 3, pp. 34-40, 1911.

[9] The actual motion picture record lasts for only three or four seconds, but by printing this short cycle many times, a reel can be made suitable for projection to give the effect of a true motion picture.

[10] Schopper, E., Die Hilfsmittel des Leuchtschirmkleinbildes und seine Detaildeutlichkeit, Agfa Roentgenblatter, Vol. 9, No. 2-3, pp. 18-33, May, 1939.

[11] Hirsch, I. Seth, Fluorography, the Photog. of the Fluoro. Image, Amer. J. of Roentgenology, Vol. 43, No. 1, pp. 45-52, Jan., 1940.

[12] de Abreu, M., Collective Radiography, Radiology, Vol. 33, No. 3, pp. 363-371, Sept., 1939.

sponsible for the introduction of the work in the United States since it was he who acquainted D. O. N. Lindberg of Decatur, Illinois, with his technique and Lindberg brought the method to this country.

Factors In Obtaining Optimum Results

There are many factors which govern the quality of the results in fluorography[13,14,15,16,17].

1.) The efficacy of the radiant energy or electron stream to excite fluorescence. In the case of medical radiology, the energy of the incident x-ray beam is limited by the capacity of the tube and by the tolerance of the patient's skin.
2.) The light producing power of the fluorescent screen, which varies qualitatively and quantitatively according to:
    a.) the chemical composition of the screen.
    b.) the color energy distribution of the fluorescent radiation.
3.) Sharpness factors dependent upon additional screen characteristics; namely,
    a.) graininess of screen structure, whether coarse or fine.
    b.) time-lag of screen.
4.) Characteristics of camera lens, including
    a.) light gathering power; e.i., the lens speed.
    b.) sharpness of lens at wide apertures.
5.) Sensitivity of film to light energy emitted by screen.

Space does not permit a complete discussion of all of these factors. However, several require at least brief coverage, but not necessarily in the same order as given.

In view of the fact that fluorography involves the use of an optical system, certain limitations are immediately imposed. It can be shown

[13] Stewart, W. H., Hoffman, W. J., and Ghiselin, F. H., Cinefluorography, Amer. J. of Roentgenology. Vol. 38, No. 3, pp. 465-469, Sept., 1937.

[14] Janker, R., The Photography of the Fluoroscopic Image: Single Exposure and Roentgen Cinematography, Roentgenpraxis, Vol. 11, pp. 271-284, May, 1939.

[15] Private Communication from W. H. Turner, The Patterson Screen Co. It is stated that the calcium tungstate used in the Patterson Intensifying Screens and the zinc sulphide used in the Type B fluoroscopic screens have no discernible afterglow. Any afterglow present would be of the magnitude of small fractions of a second. However, the Patterson Photo-Roentgen or Fluoroazure Fluoroscopic screen has a definite afterglow. These screens as used in fluorography do not have a sufficiently persistent afterglow to influence the results. The persistence of the afterglow is in relation to the excitation energy received by the screen. A heavy dosage of x-rays or daylight would cause an afterglow as long as a half-hour. This afterglow can be quenched by exposing the screen to deep red or infra-red radiation. (See also Fluorescence and Phosphorescence, E, Hirschlaff, Chemical Pub. Co., New York, 1939).

[16] Schopper, E., Die Hilfsmittel des Leuchtschirmkleinbildes und seine Detaileutlichkeit, keit, Agfa Röntgenblätter, Vol. 9, No. 2-3, pp. 18-33, May, 1939.

[17] Bouwers, A., The Indirect Radiography, Radiology, Vol. 33, No. 3, pp. 357-362, Sept., 1939.

that at present it is not possible to equal the quality of contact radiographs simply because of these optical barriers.

In contact radiography, the entire radiation within an angle of 180 degrees (and greater when two screens are employed) is utilized in exposing the film. With a lens system, the radiation is limited by the acceptance angle of the objective. Accordingly, lenses of widest aperture are preferred in order to lessen the demands upon x-ray tube and screen in producing a brighter image.

A mathematical approach to the conditions required for optimum results has been made by A. Bouwers[18,19]. His *Law of Uniformity* dictates that optimum radiographic conditions are established when the three major causes for unsharpness are equal. Thus,

$$U_m = U_g = U_s$$

where U_m is the unsharpness due to movement, U_g is the geometrical unsharpness and U_m is the unsharpness due to screen factors. (Mean values of U_m and U_g are assumed). The *Law of Uniformity* is based upon the fact that the product of the three factors is a measure of the amount of light reaching the film and, for a given product, a given density results. But the sum of three numbers with constant product is *smallest* when the numbers are equal and since the total unsharpness is the sum of the three factors it is best that they be made equal.

With fastest lenses, the light per square centimeter upon the film in fluorography is only about one-tenth that per square centimeter incident upon the film in double-screen contact radiography. Accordingly, if a film of equal sensitivity to the normal x-ray film were used and the energy output from the tube remained constant, then an exposure *time* increase of 20 would be necessary. This would cause U_m to be intolerable, as well as endanger the x-ray tube and the patient.

The *Law of Uniformity* shows the best conditions in such an instance. Since, $U_m = U_g = U_s$ and because the product in this case must be twenty times greater; that is,

$$U_m \times U_{g_1} \times U_{s_1} = 20\,(U_m \times U_g \times U_s)$$

the new conditions will be best if each unsharpness factor is multiplied by $3\sqrt{20} = 2.7$. The conditions could be met by use of an x-ray tube of

[18] Bouwers, A., The Indirect Radiography, Radiology, Vol. 33, No. 3, pp. 357-362, Sept., 1939.

[19] Bouwers, A., and Oosterkamp, W. J., Fortschritte a.d. Geb. d. Roentgenstrahlen, Vol. 54, pp. 87-91, July, 1936.

wider focus, by use of a fast fluorescent screen, and by increasing the time of exposure now only 2.7 times. The unsharpness in the reduced image is then only 2.7 times that of the double-screen contact image. The loss in sharpness then is determined by the ratio of the amount of light per unit area in the small image (I′) to the amount per unit area in the direct image (I). Therefore, if k is the increase of unsharpness, it will be determined by,

$$k = \sqrt[3]{\frac{I}{I'}}, \tag{2}$$

This ration can be calculated easily by reference to figure 1, in which the geometric relation between the screen, camera lens and reduced image plane are shown. If *d* is the aperture of the lens, *f* its focal distance and *a* the screen-lens distance, then relation of the light passing through the lens to the total light emitted by the screen is:

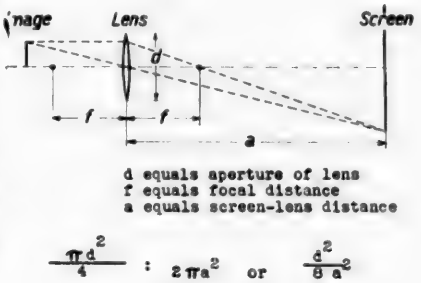


Figure 1.

$$\frac{\pi d^2}{4} : 2\pi a^2 = \frac{d^2}{8a^2}$$

If the reduction is n-times, the surface area over which the light passing through the lens is distributed will be $1/n^2$ that of the screen; consequently, the brightness of the reduced image is equal to $n^2d^2/8a^2$ times that in a film in contact with one screen or $n^2d^2/16a^2$ times that in a film between two screens. But, $n = \frac{a}{f}$ so $\frac{I}{I'} = 16\left(\frac{f}{d}\right)^2$ (3)

Now, by equation (2) we obtain for the increase in unsharpness the factor,

$$k = \sqrt[3]{16\left(\frac{f}{d}\right)^2} \tag{4}$$

A new unsharpness factor can be established if the x-ray tube voltage is increased 30 per cent and the focus-screen distance halved and is equal to,

$$k^1 = \sqrt[3]{4\left(\frac{f}{d}\right)^2} \qquad (4a)$$

Since f/d is seldom smaller than 1.5, k^1 is equal to 2.08 at best under present circumstances.

It can be shown that modern day fluoroscopic screens and films do not lower the sharpness appreciably beyond that established by the radiographic factors. Without elaborating, it is suffice to state that special screens and films have been introduced having characteristics that make them most adaptable to fluorography. The Patterson Photo-Roentgen screen is finding widespread approval as is the special film manufactured by Agfa Ansco, called Fluorapid.

The relation between film sensitivity and color energy distribution of the screen fluorescence is important. The spectral emission characteristics of Patterson screens are given in Table II as typical examples.

TABLE II

Type	*Spectral Emission*
Intensifying Screens (Calcium Tungstate)	3800 to 5200 A. (Maximum band at approximately 4300 A.)
Fluoroscopic Screens (Patterson Photo-Roentgen or Fluorazure)	3900—4900 A.
Fluoroscopic Screens (Type B)	5200—6000 A. (No sharply defined maximum band is exhibited by either type fluoroscopic screen)

The relation between the sensitivity of Agfa Fluorapid film and two fluoroscopic screens is shown in figure 2.

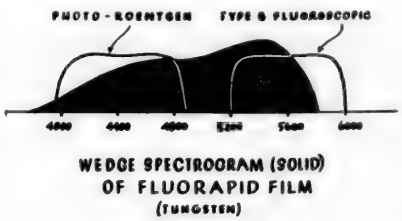


Figure 2.

In addition to an extremely high sensitivity to light of the Photo-Roentgen screen, Agfa Fluorapid film also has an unusually steep exposure-density gradient for an emulsion of such high speed. The time-gamma curve for the film is shown in figure 3 in comparison to the time-gamma curve of a film similar in threshold speed but of more normal negative contrast characteristics.

TABLE III

Worker	Camera and Lens	Type of Screen	Distance		kv Peak	ma	Time (seconds)	Film	View
			Camera to Screen	Tube-Screen					
Hirsch	35mm F/1.5 Zeiss Sonnar	Fluorazure or Patterson B.	90cm	80cm	88	150	1/10 sec.	Agfa Fluorapid Eastman Special	postero-anterior of chest
"	"	"	"	70cm	96	80	4 sec.	"	Gastro-intestinal
"	"	"	"	80cm	90	80		"	Extremities
"	"	"	"	60cm	90	160		"	Skulls
Agfa Ansco	Leica 35mm F/2	"	"	102cm	80	350	1/20 1/15 1/10	Agfa Fluorapid	Thin Chest Normal Chest Thick Chest
Abreu	F/1.5	Zinc Sulphide	90cm	60cm	80			Agfa Isochrom	Chest
Holfelder	F/1.5	"	90cm	70cm	80			"	"
Abreu	Zeiss F/1.5	Patterson G. E. Siemen's Super-Astral	90cm	60cm	*55* *50*	*50* *100*	.2—.3 .03—.05	Kodak Super XX Agfa Isopan	Adult Chest Children
Schopper	Contax or Leica F/1.5—F/2	Hektophan (Auer)	15 times reduction	80cm	80	100	.12	Agfa Fluorapid	Chest
Böhme	16mm	yellow-green fluoroscopic			80	30-50	24 to 32 frames per second		Cat Thorax
Stewart and Ghiselin	Zeiss R-Biotar, 16mm; F0.85 5.5cm focal length	Special cyanide yellow-green			100	110	16 frames per sec.	EK Super X	Heart
Files	3¾ x 3¾ F/1.5	Patterson Fluorazure (Photo-Roentgen)		48in.	55-80	400	1/10 adults 1/20 children	High Speed X-ray	Chest
Steps	Zeiss Biotar F/1.4 35mm or 2¼ x 3¼	Neossal or Super-Astral	100cm (35mm) 77cm (2¼ x 3¼)	150cm	50-57	500 to 600	.22	Agfa Isopan I.S.S.	Chest

Methods and Apparatus

The making of fluorograms consists simply in photographing the image of the fluorescent screen using a suitable camera equipped with a lens of high relative aperture (f:1.5 or f:2). The x-ray tube, the patient, the screen and the camera are placed in direct line and properly spaced as shown in figure 4.

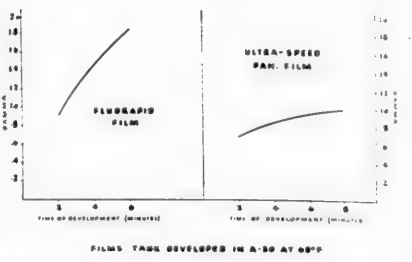


Figure 3.

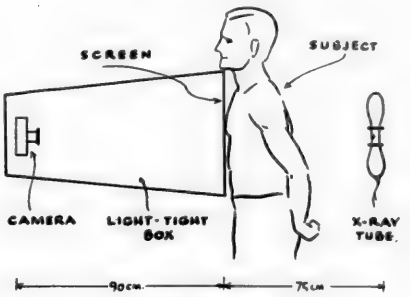


Figure 4.

The x-ray equipment should be of at least 150 Ma capacity and with tube of the rotating anode type capable of operating at 100 Kv loads.

For guide in exposure, Table III has been prepared giving data recommended by various workers.

For processing the film, standard x-ray developing and fixing solutions are recommended.

The fluorograms are projected (unless of 4 x 5 inch size, such as now used by the U. S. Army) and many 2 x 2 inch slide projectors are suitable. A projecting arrangement used by Hirsch is shown in figure 5.

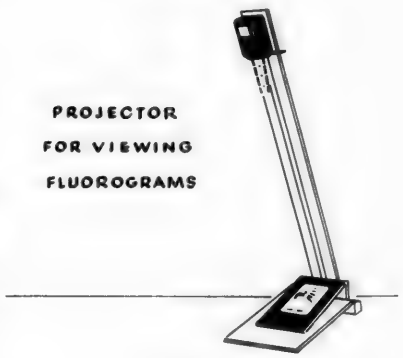


Figure 5.

Conclusions

It can be stated in brief that there is no question but that fluorography has its place in preventative medicine and is a process that should be mastered by nearly every clinical photographer. For a review of the advantages of the process, reference should be made to the article by Hirsch, entitled, "The Utility of Fluorography"[20].

[20] Hirsch, I. Seth, The Utility of Fluorography, Radiology, Vol. 36, No. 1, pp. 1-11, Jan., 1941.

Photomicrography in Color

by R. K. Waller and C. Breedis*

FALLON[1] has pointed out the value of color photographic records in medical teaching and has summarized the more recent work in this field. Photomicrographs in black and white are suitable for hematoxylin and eosin stained sections, but are wholly inadequate to demonstrate the vivid contrasts of sections stained by differential methods such as that of Masson. However, color film is not only more expensive but also more difficult to expose correctly. The difficulties are due mainly to different qualities of light sources and to the small latitude of color material, so that correct rendering of color can be obtained only within a very small range of exposure.

It is the purpose of this article to describe an apparatus and method we have been using to obtain correctly exposed photomicrographs in their proper colors.

Apparatus

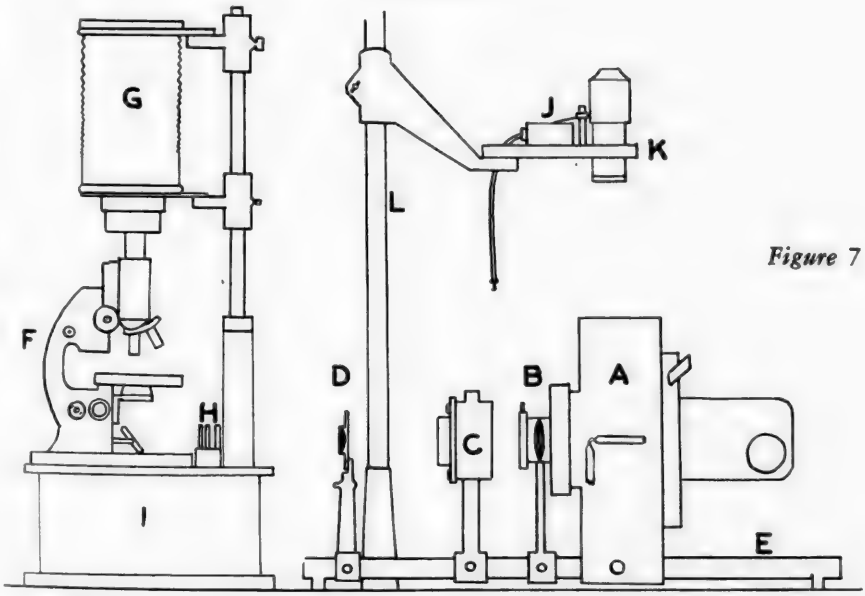


Figure 7

* Received for publication September 15, 1941 from the laboratories of Flushing Hospital, Flushing, L. I., New York and St. John's Long Island City Hospital, (Jacob Werne, M.D., Director).

[1] Fallon et al, The Doctor as Photographer, Fallon Clinic, Worcester, Mass., 1941.

The apparatus is shown in figure 7. It will be described in some detail in order to illustrate the technic, and also because it is not manufactured in its present form. The lighting equipment is mounted on an optical bench that was originally intended for use with a horizontal camera. The horizontal camera has been replaced by a vertical camera. However, any standard photomicrograph equipment should produce similar results. The source of light is a 10 Amp., AC automatically fed arc lamp (A). A lamp condenser (B), water cell (C), and supplementary condenser lens (D), are mounted on the optical bench (E). A Compur shutter having an aperture of 35 mm. and speeds ranging from 1 to 1/200 seconds is attached to the water cell on the side facing the microscope. The microscope (F), camera (G), and a rack for filters (H), rest on a wooden stand (I).

The microscope is a Zeiss EBC stand with an achromatic condenser, NA 1.4. Zeiss-Winkel photo-oculars (9 X, 6 X, 4 X,), apochromatic objectives, (90 X, 60 X, 20 X,) and achromatic objectives (45 X, 10 X,) were used. The camera (G) is a Zeiss Hegener vertical stand, 9 x 12 cm., with adaptors for 3¼ x ¼ inch films or plates.

An arrangement for photomicrography with 35 mm. film is also illustrated in figure 7. A Leica camera (J) is attached to a rotating focusing attachment (K) that slides on an upright (L) for the Leitz reproduction apparatus[2], which is mounted on the baseboard in such a way that the camera may be swung over the microscope.

In order to determine exposure time, two types of exposure meters were used; the Weston Master, Model 715, and the Photrix Universal Photometer, Model A[3].

DESCRIPTION OF PLATE*

All sections were counterstained with hematoxylin and light green. The granules demonstrating the presence of phosphatase appear brown or black in the color photomicrographs.

Figure 1. Mouse kidney. 600 X

Figure 2. Mouse kidney, control. 600 X

Figure 3. Mandible and tooth anlage of a mouse embryo measuring 20 mm. in length. 98 X

Figure 4. Chicken liver (carmine particles injected ante mortem). 300 X

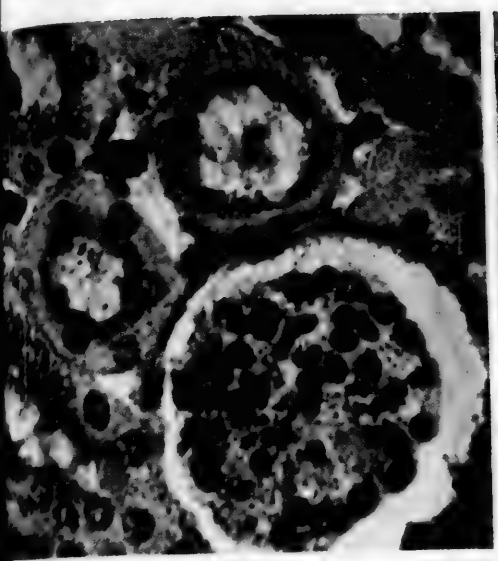
Figure 5. Fibro-adenoma of the breast (human). 98 X

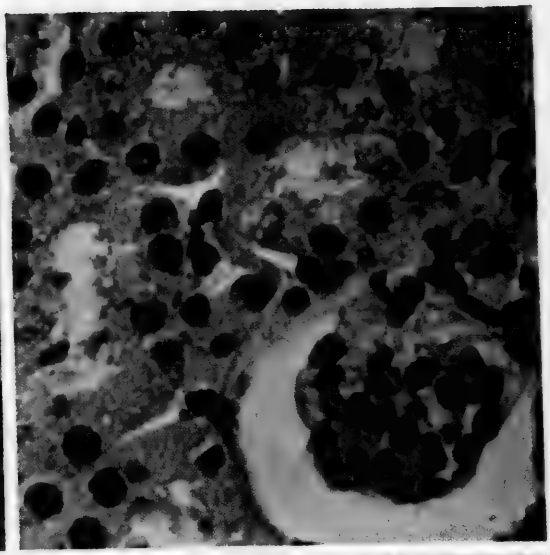
Figure 6. Small intestine of a mouse embryo. 67 X

* These photographs were prepared by the authors for an article by Drs. Kabat and Furth, "A Histochemical Study of the Distribution of Alkaline Phosphatase in Various Normal and Neoplastic Tissues." (Am. J. Path., 1941, 17:303-318) and are reproduced by courtesy of Drs. Kabat and Furth and The American Journal of Pathology.

[2] Freivogel, H. & Breedis, C., Photographing Fresh Autopsy Material in Color with Polarized Light. J. Biol. Photo. Assn. 8:173-177, June, 1940.

[3] Lent by courtesy of Photovolt Corporation, New York.





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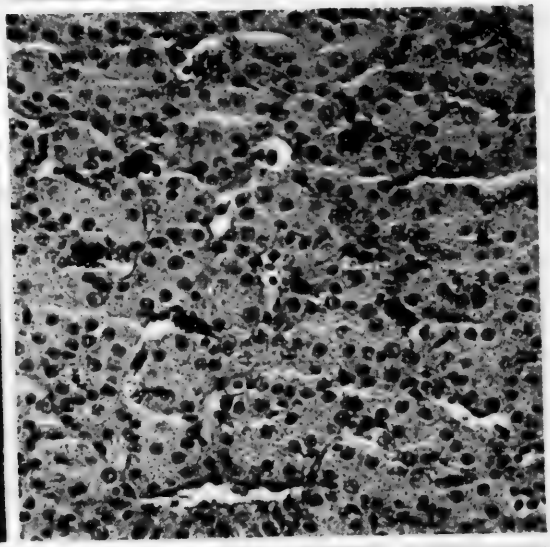

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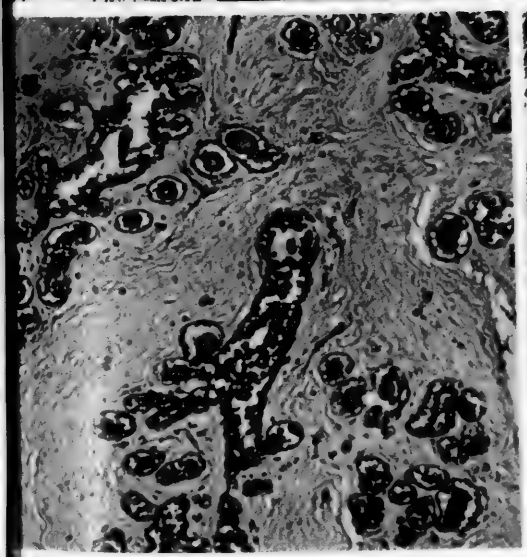
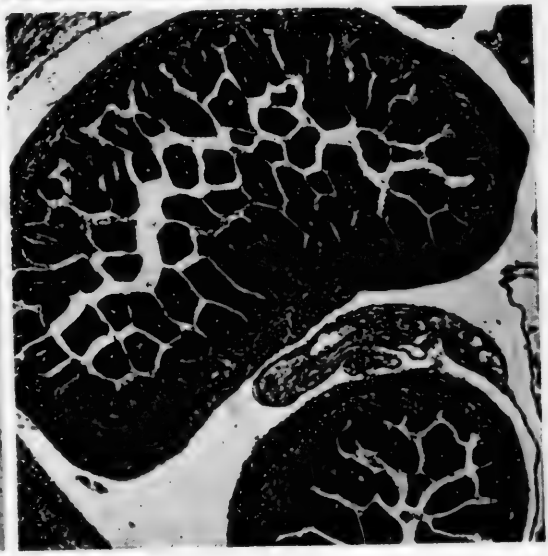




6

Almost all of our color photomicrographs have been taken on Kodacolors when a light source having a color temperature of 3200° for the few taken on 35 mm. Kodachrome film are on the whole less satisfactory.

Technic — Light Source and Filters

A convenient measure of the quality of light used for illumination is its color temperature[4]. Kodachrome Type B film accurately renders colors when a light source having a color temperature of 3200° Kelvin is used. The temperature of our arc, operating on 10 Amperes, AC, was found to be 4500° Kelvin as measured with an Eastman Kodak color temperature meter. The light was adjusted to 3200° Kelvin by passing it through three filters, namely, Wratten filters No. 2A and No. 86C, and a Bausch and Lomb neutral density filter 0.3. The two Wratten filters are recommended by Eastman Kodak company[4] for this purpose. However, it was found that these filters did not reduce the color temperature sufficiently. Adding the neutral density filter produced the desired results.

Centering of Light

It is important that the light beam is accurately centered, especially for color photomicrographs. The condensing lenses are not corrected for color and, as a result, light passing through their edges shows dispersion colors. If the diaphragm is closed down, this phenomenon is accentuated.

Adjustment of Illumination

A modified Köhler illumination[5] was used. The method consists essentially of projecting an image of the light source onto the plane in which the microscope condenser diaphragm lies. First, the light is centered by adjusting the arc and the mirror. The arc is focused on the microscope condenser diaphragm by moving the lamp condenser. The objective is then focused on the specimen and the microscope condenser is moved on its rack until the opening of the light condenser diaphragm appears sharply in focus. After this, the light condenser diaphragm is opened until an area just slightly larger than the desired field is illuminated. In obtaining a similar type of illumination with medium or low power objectives, the larger field makes it necessary to remove the top lens of the microscope condenser.

An even larger field may be obtained for very low power work. The microscope condenser is removed from its holder, the top lens

[4] Light Sources for Kodachrome Photography, Rad. & Clin. Photo., No. 2, p. 16, 1940.
[5] Richards, Oscar W., Color and Illumination in Photomicrography, J. Biol. Photo. Assn., 9:77-86, December, 1940.

screwed off, and the lower part of the condenser placed upon the stage. The slide is then placed directly on the condenser and the extra light cut off by closing down its diaphragm. By this method, a 28 mm. lens was used without ocular or draw-tube to obtain magnifications as low as 10 diameters.

Determination of Exposure Time

To avoid the usual trial and error method of determining exposure time, which becomes expensive when color film is used, we attempted to develop a more exact method. At first, the comparison of Wratten M plates and Kodachrome film, exposed under the same conditions, was tried, using the former as a guide. This method was time consuming and led to errors. We later found that the exposure time could easily be calculated from the intensity of light falling on the plate, as measured by means of an electric light meter.

If light of the proper characteristics is used and the film has been properly exposed, the background, that is, the clear unstained portions of the slide, appears clear or slightly gray. For example, figures 3 and 6 of the color plate have backgrounds which are slightly blue. These photographs were taken with light having a color temperature of 4500° Kelvin, which is too high for Kodachrome B film. That of figure 4 is almost white. The colors of the specimen appear more deep and stand out more sharply when the film has been so exposed that the background appears slightly gray. This grayish tinge is not noticeable on projection.

For any color film that has been exposed "properly" according to the above criteria,

$$E = k\frac{I}{L} \tag{1}$$

where E is the correct exposure for a given intensity, L, of light falling on the background, and k is constant provided that only the intensity and not the quality of the light varies.

For practical purposes, both the Weston and Photrix meters give readings directly proportional to the intensity of light falling upon them in the range 0 to 25 foot candles, so that;

$$R = cL \quad \text{and} \quad L = \frac{R}{c} \tag{2}$$

where R is the meter reading for a given intensity, L, of light and c is a constant depending upon the method of calibrating the meter.

Substituting (2) in (1),

$$(3) \qquad E = ck \cdot \frac{I}{R} \qquad\qquad E = K \cdot \frac{I}{R}$$

where K is constant for a given type of film, provided that the light falling upon the film is of constant quality and is always measured in the same plane as the film.

The value of K in the last equation is found by trial and error, as follows. The illumination is adjusted as described previously and the specimen is brought into focus on the ground glass of the camera. Then the specimen is moved entirely out of the field, the ground glass is removed from the top of the camera and the exposure meter is held in its place while a reading is made. The specimen is again moved back into the field, with some of the clear background showing. One or two films are then exposed in a series of strips of increasing exposure times, attempting to include the correct exposure time in the series. When such a correct exposure time is found, it and the meter reading are substituted in equation (3) and K is solved for. A table may then be prepared from the equation to give the exposure times required for different meter readings.

As has been stated, K is different for different light sources and different filters. For Kodachrome Type B film, exposed to carbon arc light previously adjusted to 3200° Kelvin by means of the filters mentioned above, we found K to be 0.53, when R was determined with the Weston meter.

For convenience in calculating exposures of less than one second, K may be expressed as a fraction. Then,

$$E = \frac{I}{1{\cdot}9} \cdot \frac{I}{R}$$

The exposure time for a given meter reading is obtained by simple multiplication of the denominators.

It should be noted that the Weston meter is not sensitive enough to record accurately light which requires exposures more than one second.

When lightly stained sections are to be photographed, it makes little difference whether the meter reading is taken from the clear background or the specimen itself. If the specimen contains many darkly stained areas, as in figure 3 of the color plate, these areas filter out a considerable

amount of light and consequently give a too low meter reading. This results in a corresponding over-exposure of the film.

SUMMARY

An apparatus and method for photomicrography in color are described, with special attention to lighting.

A simple method is given for the determination of correct exposure time by means of an electric exposure meter.

BOOK REVIEWS

DIRECTORY OF MICROFILM SOURCES INCLUDING PHOTOSTAT SERVICE. R. C. Cibella, Special Libraries Association. 31 East 10 Street, New York City. 75 cents.

The libraries are listed with equipment and services offered. The increasing use of 35 mm. film for copying books and other loan material is a field which should be of much interest. — O. W. R.

THE YEAR'S PHOTOGRAPHY, 1941-1942. Royal Photographic Society Publication, London. Price: Two Shillings and Sixpence.

This volume indicates that photography, in general, has not suffered, nor has there been a falling off of interest in the subject. Fifty reproductions of a pleasing variety of subjects, are presented in excellent half-tone, which demonstrate that the British "carried on" in spite of war conditions and limitation of supplies.

An interesting review of the Annual Exhibition is presented by the president, F. J. Mortimer, F.R.P.S., F.R.S.A.; Edgar R. Bull, F.R.P.S. discusses, The Lantern Slides; and Hugh G. Wagstaff, F.R.P.S. reviews the section on, Nature Pictures and Records.

The high technical quality so characteristic of this Annual is again apparent.

Photography of the Breast

by Albert Sadler*

THE inability of the camera to effectually differentiate between the three types of tissue in whole gross sections of breast has long been recognized. These three tissue formations are: fibrous tissue (so-called breast tissue), fat and tumor tissue. The overlying skin is omitted, because the author, dealing with the differentiation of breast substance only, considers the surface epithelium sufficiently evident and obvious to anyone, without the need for special treatment.

Fibrous Tissue

This is composed of pearly gray to white rubbery tissue, either in masses or in strands, depending on the type of pathology present. It may be interspersed with small pinhead sized cysts. In cystic mastitis, it is not uncommon to find cysts two or three centimeters in diameter, and occasionally larger. The cyst lining is usually pearly gray in color.

Fat

The fat of the breast is of good color, ranging from pale yellow to light orange. However, it is usually of a medium yellow, similar in hue to a K2 filter. There is a fine network of connective tissues holding the lobules together.

Tumors

New growths found in the breast are for the most part malignant. There are many classifications, and they are of varying size. The carcinomata are the most common, and while they differ considerably in their gross appearance, their color range is quite narrow, varying from light to medium gray, with sometimes a sprinkling of yellow.

Sarcoma of the breast is comparatively uncommon. These tumors often appear grossly like medullary carcinoma and, therefore, are of the same color. A few, however, are a very light gray, presenting the typical "fish flesh" appearance. Where necrosis and ulceration occurs in tumors like these, the color change is not remarkable, unless hemorrhage also is present. Differentiation in the photograph is more a matter of lighting than tissue contrast.

*Received for publication August 20, 1941 from the Department of Pathology, St. Vincent's Hospital, New York City.

Adenomata, either adeno-fibroma or fibro-adenoma, are sometimes found, usually alone, but occasionally in conjunction with a malignant change. These tumors are nearly always circumscribed and encapsulated. The capsule does little to define them in the print. They are very light to light gray in color.

Discussion

It will be seen, therefore, that breast and tumor tissue, more often than not, are of the same shade of gray, except where extremes are present. Both photograph in the same shade of gray, and often are indistinguishable in the print. To make matters worse, the fat, which to the naked eye offers a strong contrast to the other tissue, fails to do so in the print, and appears as a gray of about the same density as the rest of the organ. Unless one has studied the gross specimen, the photograph is meaningless to the average pathologist or surgeon.

We are faced with the problem of differentiating these three elements in the print, so that they will be easily recognized for what they are. In other words, since the film is equally sensitive to them, tumor and breast tissue must be made to differ in shade, and both must be contrasted against the fat. One must be made either darker or lighter than the other. Speaking in theory, or in giving technical advice, one would say, use a yellow filter. This should lighten the fat and leave the other tissue a darker gray. In practice, however, it does not make enough difference to serve the purpose. If we use an orange filter and make the fat to appear white, the result is, perhaps, photographically correct, but from a pathological standpoint, the picture is lost. Fat is a lighter, or should we say brighter substance than the other elements, and must be so depicted in the photograph, while at the same time, it's detail must be retained. A complementary filter (blue) would render the fat very dark, and this is unsatisfactory, because it no longer looks like fat, but takes on the appearance of muscle. In addition to being of little value, neither filter will give any differentiation between the breast and tumor tissue.

The only alternative is selective staining, just as we stain a section for microscopic examination or photomicrography. In reviewing the literature, the author has not found any direct reference to selective staining of gross specimens of breast for photographic purposes, nor have any articles been found on this subject. This does not mean that no references or articles have appeared, neither is any originality claimed by the author. As a matter of fact, Boyd[1], has one illustration in which the fat is gray, and the fibrous tissue white, and another in which the fat is white and

[1] Boyd, William, Text Book of Pathology, 2nd Ed. (1936) Ch. XXIII, p. 731, fig. 309; p. 738, fig. 317.

lacking in detail, with the tumor light gray. Apparently these are both straight photographs, processed to a fairly high contrast.

Ewing[2], publishes photographs in which the fat is a slightly darker gray than the tumor, but the process is not obvious. These specimens may have had the fat stained, or have been fixed in formalin for a considerable period. It is also possible that they were taken on non-color sensitive film, since this medium would cause the yellow to appear dark. Delafield and Prudden[3] illustrate a section of breast apparently stained with Sudan III. Bell[4] has two photographs in which the differentiation between fat and breast tissue is evident, but while the fat is light gray, the fibrous tissue is white and lacking detail. Bloodgood[5] shows four photographs in which the contrast between fat and tumor is not marked except in one case. The latter shows an adenoma surrounded by fat, the fat being rather dark, and the tumor light gray. Apparently the fat has been stained. Several other text books on pathology, diseases of the breast, and cancer, do not contain photographs of gross specimens of breast. Instead, they are illustrated with drawings.

It is now apparent that the usual practice has been to either use straight photographs of subjects of a contrasty nature, or to employ a stain to render the fat darker than the rest of the specimen. The stains used would be Sudan III or Sudan IV (Scharlach R). The use of non-color sensitive film must also be added. None of these methods give a true rendition of the picture visualized by the naked eye. None of them differentiate between fibrous tissue and tumor growth. With either panchromatic or orthochromatic emulsion, a straight photograph usually gives a one tone picture. The problem is to obtain a monochromatic rendering of the gross section of breast to show the pathology, and at the same time, to preserve the tone values according to the visual perception.

The method employed, following a series of experiments, differs from the previous ones, in that while they darken the fat, and leave both tumor and breast tissue as it is, the author's method darkens the tumor and fibrous tissue, leaving the fat as it is. In the experiment, conducted on a single carcinomatous breast sectioned into thin slices, one section was photographed unstained (figure 1), and the other sections were separately stained in the following dyes:

[2] Ewing, James, Neoplastic Diseases, 4th. Ed. (1940). Ch. XXVI, pp. 563-565, figs. 256-258.
[3] Delafield, Frances, and Prudden, T. Mitchell, Text Book of Pathology, 8th. Ed. (1939). Ch. X, p. 802, fig. 563.
[4] Bell, E. T., Text Book of Pathology, 2nd. Ed. (1934) Ch. XII, p. 272, fig. 152; Ch. XIII, p. 354, fig. 208.
[5] Bloodgood, Joseph Colt, Border-line Breast Tumors, American Journal of Cancer, Vol. XVI, No. I, Jan., 1932, p. 118, fig. 3; p. 136, fig. 23; p. 140, fig. 28; p. 169, fig. 53.

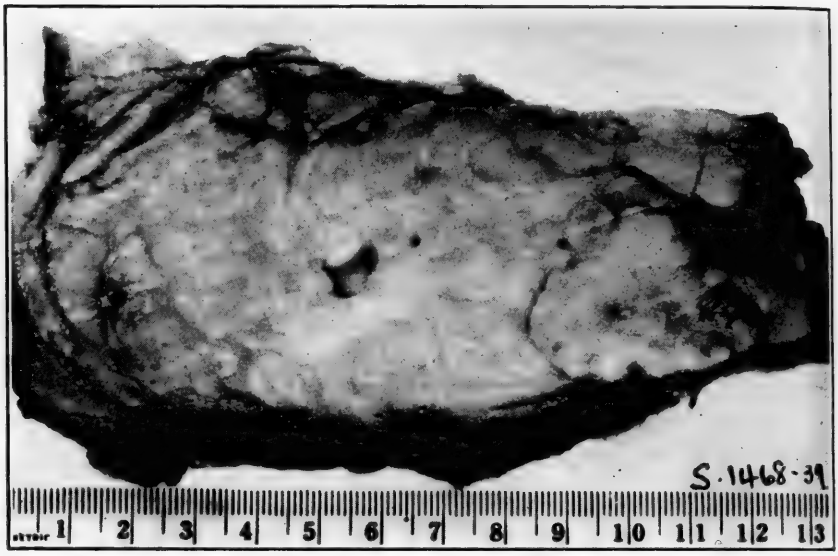


Figure 1. Straight photograph of a section of breast. Kine Exacta (24 x 36 mm.). 50 mm. Exactar f:3.5 with Proxar. Finopan film, two seconds, f:16, two No. 1 photofloods with screens.

Sudan IV. This being the old method and used for comparison. Here the dye is precipitated in the fat, making it red, while all other tissue remains unstained. *Result.* The fat is a dark gray, and the rest of the tissue light gray.

Van Gieson. This stained the fibrous and connective tissue red, leaving the fat unstained. The tumor was also of the same shade of red as the fibrous tissue. *Result.* The fat appears light gray, while the rest of the organ is an even dark gray.

Metachrome. This dye stained everything but the fat a purple color. *Result.* The fat was gray, and everything else very dark.

Thionin. This gave a poor result, staining similar to Metachrome.

Eosin and Metachrome. The eosin was applied to the cancer area, making it light red, and the metachrome applied to the fibrous tissue, staining it purple. *Result.* Unsatisfactory, for the fibrous tissue was extremely dark, the tumor a muddy gray, and the fat light gray.

Methylene Blue. The tumor stained dark blue, fibrous tissue medium blue with pinhead cysts very prominent. The fat remained unstained, with it's connective tissue a dark blue. *Result.* This was excellent, for here, chronic mastitis and carcinoma were readily differentiated, (figure 2).

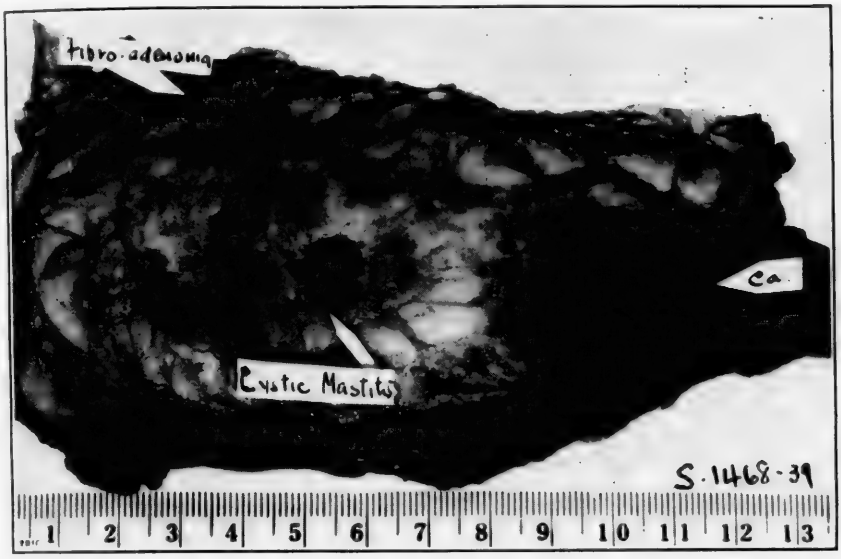


Figure 2. Straight photograph of the same section after staining with methylene blue. Kine Exacta (24 x 36 mm.). 50 mm. Exactar f:3.5 with Proxar. Finopan film, two seconds, f:16; two No. 1 photofloods with screens.

In figure 1, the fat and tumor are indistinguishable, and the difference between fat and fibrous tissue is very slight. The small cyst is not prominent. In figure 2, both the adenoma and carcinoma are contrasted in a darker gray than the rest of the tissue, and they show good detail. The fat is light, and it's connective tissue plainly shows the lobules. The fibrous tissue, exhibiting chronic cystic mastitis, is marked by the definition of the numerous small pin-head cysts which are invisible in figure 1. The large cyst shows depth and is well brought out. The fibrous tissue and ducts are easily distinguished from the fat. The first photograph is that of a section of breast, and the second photograph is that of the pathology in the same section of breast.

TECHNIQUE

The technique is simple. Immerse the section in a .01 per cent (point zero one per cent) aqueous solution of methylene blue for 30 seconds to one minute. Rinse the specimen and blot away the surface moisture. An excess of stain can be washed out in a few minutes. The degree of darkening can be controlled by the length of staining, and the dye can be removed later in acid alcohol, and therefore, the specimen is not spoiled. The results are constant, and in the author's opinion, su-

perior to the former method of darkening the fat. In these experiments, fine grain panchromatic film was used, and the factors were the same for each section and print.

Conclusions

1. A method is described whereby the three elements of whole breast sections may be differentiated photographically, to give a good monochromatic picture.
2. It differs from previous methods in that the fat is rendered light instead of dark.
3. It readily brings out details in chronic cystic mastitis which are not even clear to the naked eye.
4. It sharply demarcates new growths from the normal breast tissue.
5. It is simple and easy to use, does not spoil the specimen and the results are constant.

MECHANISMS OF BREATHING*

ANTON J. CARLSON AND VICTOR JOHNSON

(400 feet, monochrome, sound)
Distributor: Erpi Classroom Films Inc.

This picture reveals mechanism of breathing by means of animation and some natural photography. Technical animation portrays the respiratory system and muscular activity involved in breathing, gaseous exchange in the lungs and body tissue cells with reference to pathological conditions, the nervous control of breathing and factors affecting the rate and depth of breathing. The natural photography includes a bell-jar demonstration showing action of animal lungs and diaphragm action, capillary circulation and artificial respiration.

This sound picture is recommended for elementary and undergraduate college students. E. J. Farris.

* Reprinted with permission from the Anatomical Record. Reviews of Approved Films in Anatomy and Biology. Vol. 80, No. 4, August, 1941.

The Larynx, Bronchi, and Esophagus in Kodachrome

by J. D. Brubaker and Paul H. Holinger, M.D.*

PHOTOGRAPHY of many of the body cavities has become a well recognized, routine method of recording their normal anatomy and diseased states. Advances in the field of photography have left few of the body cavities inaccessible to the camera. To visualize the deeper parts of the respiratory and digestive tracts, however, and to photograph them through the mouth, it has been necessary to develop special equipment which was evolved through a compromise of many limiting factors, some dependent upon fundamental photographic principles and others dependent upon the configuration of the air and food passages. In designing the equipment, the safety of its use in the patient was considered paramount. Ease of manipulation, constant visualization of the field, both during the introduction of the instrument and during the actual photography, axial illumination, and a relatively great depth of focus were all considered to be essential features.

Two cameras were built to fulfill these prerequisites and are herein described; one is used for still flash pictures of the larynx, the other for motion pictures of the larynx, tracheobronchial tree and esophagus.

Camera for Kodachrome Still Pictures of the Larynx

The optical arrangement of the still camera is similar to an original model built for Dr. J. M. Garner and Dr. J. P. Nesselrod[1] for proctoscopic Kodachrome still photography[2]. The camera, as adapted for laryngoscopic work, has been reduced in weight and combines the camera, flash bulb, focusing lamp and a telescope in one instrument[3]. The various components will be described separately, the assembled unit being illustrated in the accompanying photograph (figure 1).

* Received for publication October 9, 1941 from J. D. Brubaker, Photographic Engineer, Evanston, Illinois, and Paul H. Holinger, M.D., Associate in Laryngology, University of Illinois, College of Medicine, Chicago, Illinois.

[1] Garner, Jay M. and Nesselrod, J. Peerman, Proctoscopic Cinematography, Proceedings Institute of Medicine, Chicago, 13:387, May 15, 1941.

[2] Brubaker, J. D., Proctosigmoidoscopic Cinematography in Kodachrome, J. Biol. Photo. Assn., 9:92-95, December, 1940. (The still camera is mentioned and sample black and white reproductions from Kodachrome can be found here.)

[3] Patent applied for by J. D. Brubaker.

A Leica camera is used with the synchronizing contacts in the base for firing a flash bulb during the 1/20 second interval that the shutter is open. The lens is a four inch focal length apochromat Goerz f:9.5 lens, operated at f:11 to f:16 at 1/20 second for Kodachrome. It is mounted in a housing behind a hole in a 45 degree angle mirror, the mirror reflecting the light from both a focusing lamp and finally the flash lamp down the narrow laryngoscope and onto the field. The focusing lamp is a 5 ampere 10 volt exciter lamp operating through a condenser so that its light shines through the wire filled flash bulb onto the 45 degree mirror and down the main axis of the instrument. It is bright enough to permit accuracy in centering and focusing the field. The flash bulb is a wire filled Press-40, inverted, with the center of the flashing wire on the axis of the condenser. Thus, it is in position to fire at any time. Due to the short peak of the bulb, the effective speed is about 1/30 second, the camera utilizing all the light from the bulb.

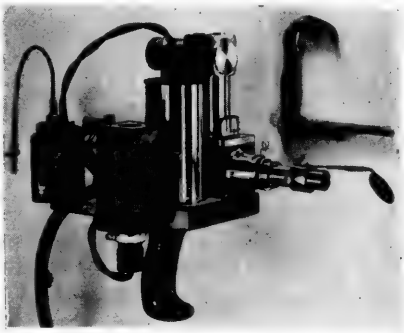


Figure 1. Laryngoscopic Kodachrome still camera.

A magnetic tripping device on the instrument releases the camera either by an electrical foot switch or by a push button on a cord. These optional controls connect to the carrying case and control the three volt battery circuit. The focusing lamp operates from a small step down transformer in the carrying case. Thus, with all circuits at the instrument at low voltage, there is no possibility of the 110 volt line grounding on the instrument and shocking the patient or camera operator.

One of the most important features of this camera is the telescope which permits continuous visualization of the field, magnified about seven times. This magnification is low enough to allow the operator to see all of the field to be photographed, and yet it is high enough to permit accurate focusing of the object without the use of a ground glass screen. The accommodation of the eye is shallow enough in relation to the rest of the system so as to cause no trouble. The appearance of the field as seen through the telescope has about the same depth of focus and appearance as will be seen in the finished transparency.

Both the telescope and the camera are fixed in adjustment, and are both focused upon the same plane in the object space about eight inches beyond the front of the instrument. The whole equipment is moved by

means of the handle to bring the object into focus. Since the point of focus is a fixed distance in front of the light mirror, the light intensity from the flash bulb will always be the same, an important factor when using Kodachrome. Thus, all conditions are fixed, permitting duplication of results on similar work.

The area photographed in the plane of the object is a circle about 1¼ inches in diameter. The image on the film is 0.45 life size. With the use of the apochromat lens, details of the object as small as .002 to .004 of an inch in diameter can be recorded, the resolving power limit of the film and lens.

As previously stated, the equipment is designed for taking pictures through the laryngoscope or by means of a mirror rigidly attached to a short sleeve inserted into the front of the instrument. The sleeve serves to concentrate the light on the field. Ordinary number 5 to 7 laryngeal mirrors are used, held in an adjustable collar on the sleeve so that the proper distance from the mirror to the area photographed can be adjusted quickly. For pictures of the larynx, the mirror is directed downward. By inverting the mirror, satisfactory pictures of the post-nasal pharynx have been taken. For indirect photography, the laryngoscopic mirror is heated just prior to its use in order to prevent moisture condensation on its face. For direct photography, a pre-heated, optically flat glass slide is fitted into a slot at the front of the main housing to protect the optical parts from fogging by moisture condensation as the patient breathes or coughs. Several spare slides are kept heated for quick change should the patient cough secretions onto the slide in the camera.

For direct photography, a short sleeve sliding inside a standard laryngoscope may be used, but specially made tubular laryngoscopes attached to the camera have proven more satisfactory. Since the telescope permits visualization of the field at all times, these laryngoscopes may be introduced while attached to the instrument. This eliminates the difficulty of too many hands near the operating field, and makes possible a slightly larger diameter photographic field.

Minor adjustments of the f stop by an external knob is the only change made in the equipment from time to time. The knob can be locked into position. All focal adjustments are fixed when the equipment is built.

The base of the instrument fits into a recess in the carrying case so that when the lid of the case is closed, the camera is held firmly in place. With this method of carrying, the equipment is capable of withstanding moderately hard mechanical shock without damage.

KODACHROME MOVIE PHOTOGRAPHY OF THE LARYNX, BRONCHI AND ESOPHAGUS

The basic design of the movie camera equipment is similar to that previously described in this Journal[4] with certain improvements and several features especially designed for laryngoscopic, bronchoscopic, and esophagoscopic motion picture photography in 16 mm. Kodachrome.

In this instrument, the lamp, telescope, and movie camera are combined in one unit[5], either held in one hand or on a tripod (figure 2). Again the various components will be described separately, the assembled unit being illustrated in the accompanying photographs. The camera used is a Bell and Howell 141-A, operating at 12 or 16 frames per second. This is a 16 mm. magazine-loading type taking a 50 foot prethreaded cartridge of film. A motor-driven camera was not used because the usual 12 foot run at one winding was sufficient for most work and the motor drive would add more weight. The camera is controlled by a trigger in the handle.

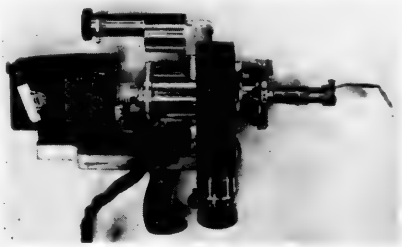


Figure 2. Movie camera with adapter, sleeve, and mirror.

The photographic lens is an 8 cm. (3⅛ inch) focal length Zeiss tessar f:2.7 in a barrel with iris diaphragm. This, of course, is not a regular movie lens. It is mounted by its screw thread in a tube which is in turn threaded inside the end-plate of the main housing (figure 3). By a choice of two different tubes cut to exact length, two different focal distances (10 and 16 inches) ahead of the instrument are available; the first for laryngoscopic photography, the second for bronchoscopic and esophagoscopic work.

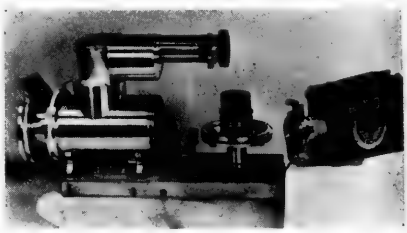


Figure 3. Movie camera. Disassembled view from left side.

The movie camera connects rigidly to the end-plate of the housing by means of a modified bayonet lock (figure 3). The bayonet lock permits easy detachment of the camera to change lens tubes and masks,

[4] Brubaker, J. D., Proctosigmoidoscopic Cinematography in Kodachrome, J. Biol. Photo. Assn., 9:92-95, December, 1940.

[5] Patent applied for by J. D. Brubaker.

and yet makes certain that the lens to film distance will be correct when the camera is again attached.

The 16 mm. movie film frame is masked by a removable circular mask, contained in the tube screwed into the front of the camera. This eliminates objectionable flare and high-lights which would otherwise appear on the corners of the film area due to reflections from the inside surface of the various endoscopes which are purposely left bright. Two sizes of masks are used. The one for the laryngoscope (10 inches) permits exposure of a ¼ inch circle on the film, utilizing the full height of the 16 mm. movie frame. The other mask has a hole about 1/10 inch in diameter and is used with the longer endoscopes described later.

A single lamp is used both for finding and focusing the field, and for the actual filming. It is a standard 108 watt, 6 volt, 18 ampere tungsten ribbon filament lamp, and is contained in a square lamphouse at the side of the instrument. The center portion of the ribbon filament is focused approximately in the plane of the object by means of a condenser and a prism which reflects the rays of light onto the main axis of the instrument. This external light source eliminates extreme variations in light intensity on structures at different distances from the camera. These variations are encountered when illumination is supplied by several small lamps mounted on the laryngoscope. A more detailed description of the various characteristics of the lamp may be found in the article previously mentioned[6].

In the present camera, the lamp voltage is automatically raised from 6 to 8 volts when the trigger in the handle starts the camera. All electrical circuits reaching the instrument are at a low voltage, and the transformers are well insulated, thus avoiding any possibility of electrical shock to the operator or patient. The light value on the field photographed is about 130 foot-candles, Weston, at a color temperature (lamp at 8 volts) of about 3300° The difference between 3300 and 3450, the proper color temperature for type A Kodachrome, is not serious and is not noticeable when the films are projected. The 130 foot-candle illumination would ordinarily require a stop of f:7.0 on the lens, but due to the optical design of the instrument, a stop of f:4.0 is actually used for nearly all work. The maximum stop as limited by the instrument design is f:3.5.

As in the previous camera, a telescope which magnifies the field about five times is used to visualize the field, not only for finding and focusing but also during the actual filming. Thus, both blind filming

[6] Brubaker, J. D., Proctosigmoidoscopic Cinematography in Kodachrome, J. Biol. Photo. Assn., 9:92-95, December, 1940.

and blind manipulation of the endoscopic instruments are avoided. The image is erect, and correct from side to side. The three optical systems of light, telescope, and camera operate simultaneously in a cylindrical space about ¾ inch in diameter within the instrument proper. The illumination level of 130 foot-candles is high enough so that good vision is obtained through the telescope and small differences of focus are easily seen and quickly corrected. The appearance of the field in the telescope is very nearly the same as will be seen on the screen when the finished film is projected. As in the still camera, the accommodation of the eye is not troublesome and no ground glass screen is necessary. Changes in the length of the telescope eye piece tube are made when changing from laryngoscopic to bronchoscopic or esophagoscopic photography to keep the telescope focused at the same point as the camera.

As in the still camera, the telescope and camera are each focused on the same object plane ahead of the instrument. Since the light source is also a fixed distance from the object, all factors are fixed and the operator may be confident that he has satisfactorily photographed the field seen in the telescope. This is especially important when a series of pictures are taken of the same patient over a period of time.

Since the still camera operates at eight inches distance, and the movie at 10, a simple adapter (figure 2) makes it possible to use the mirrors and laryngoscopes interchangeably on either the still or movie equipment as desired.

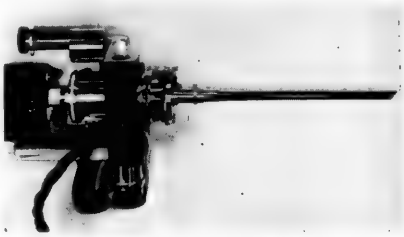


Figure 4. Bronchoscope attached to movie camera.

For pictures at the 16 inch distance, a special plain round tubular bronchoscope and esophagoscope (figure 4) are used, being of ½ and ⅝ inch inside diameter respectively. These scopes are larger than those used in routine bronchoscopy and esophagoscopy, and consequently may be used only in selected cases. The ends of the scopes are beveled at 45 degrees and each is made in two parts which telescope together near the attaching flange, giving 1¼ inches of adjustment in their length. This adjustment permits the position of the plane of focus to be set at different distances in relation to the end of the tube. Therefore, since the focal distance from the attaching clamp is constant, lengthening or shorting the tubes permits close-up views or more distant shots to give greater perspective of the different structures and pathology.

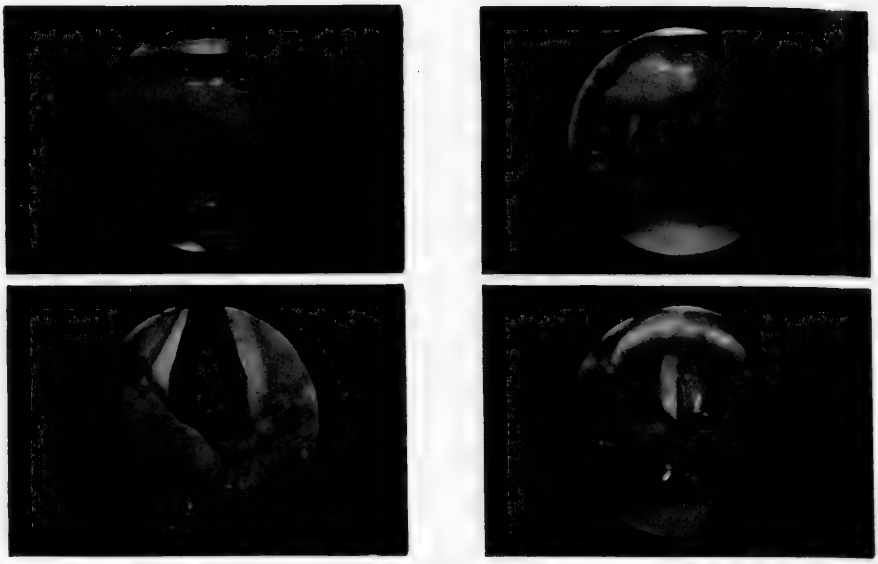
The free working distance of the special long endoscopes, as measured from the point focused upon to the shoulder of the adjusting telescoping sleeve, is about thirteen inches (33 cm.). Longer scopes might be possible from the photographic standpoint, but the film images would be too small to be useful. A specially designed attaching clamp is used to connect the various endoscopes to the camera proper. It has a recess to receive interchangeable circular black bakelite masks. These absorb the light that would otherwise flare back into the camera lens from the proximal end face of the tubular attachments of various diameters.

A row of five 5/16 inch holes is located in the tube just back of the attaching clamp to allow the patient to breathe freely when the laryngoscope or bronchoscope is in place. An optically flat, heated glass slide is again used to prevent fogging the optical parts as the patient breathes. It fits into a slot near the front of the main tube housing.

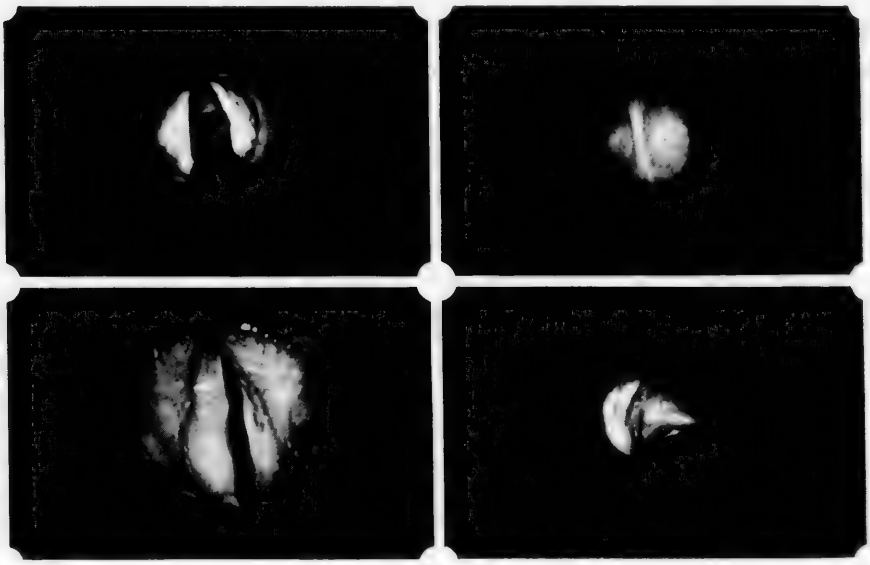
The movie equipment described may be used for either direct or indirect photography of the larynx in Kodachrome. When taking indirect pictures as in mirror laryngoscopy, the instrument is used on a tripod and the patient moved up to the mirror fixed rigidly on an extension sleeve held in the attaching clamp. The telescope eyepiece was designed to be as low as possible and still clear the top of the movie camera so that when taking indirect pictures, the left eye can see directly into the patient's mouth, while the right eye is in position to look through the telescope. This facilitates adjustment of the patient's head in relation to the mirror. When the equipment is used on a tripod, the handle is removed and a short cylindrical metal stub is screwed into the base to receive the tripod screw. When on the tripod, the camera is operated by a small knob on the control lever which may be locked down in running position if desired. When the trigger control is used with the camera held in the hand, the movie camera stops as soon as the trigger is released.

The magnification ratio of object to film image size is 0.27 for the 10 inch distance, and 0.17 for the 16 inch distance. The 0.27 magnification corresponds to a one inch circle in the object plane, giving a circle on the film the full height of the film frame. The 0.17 magnification produces a circle on the film about 1/3 the height of the frame when using a 16 inch scope with ½ inch inside diameter. For reference, a regular 16 mm. movie film frame, corresponding to the area of the film seen on the screen, is 0.284 inch high by 0.380 inch wide.

The depth of focus for very sharp definition at the object plane is about plus or minus ¼ inch, with a .004 inch circle of confusion on the film. The out-of-focus structures closer to or farther from the camera



These reproductions are taken from Kodachrome still transparencies. Original circles were about 0.4 to 0.5 inch in diameter. Top Left, Mirror view during phonation. Top Right, Mirror view of normal larynx showing epiglottis, vocal cords and tracheal rings. Bottom Left, View through laryngoscope showing arytenoids, vocal cords, and tracheal rings. Bottom Right, Mirror view during phonation. Papilloma of left vocal cord.



The above are single frame enlargements from 16 mm. Kodachrome movie film given here to show image diameter in relation to full frame. Top Left, Vocal cords as seen through ½ inch bronchoscope. Top Right, The carina at the bifurcation of the trachea (½ inch bronchoscope). Bottom Left, Normal vocal cords direct through laryngoscope at 10 inch distance. Bottom Right, Right main bronchus at junction of middle lobe (½ inch bronchoscope).

Figure 5. Black and white reproductions from Kodachrome.

cause little confusion, since they are sharp enough to orient the field focused upon as seen when the films are projected.

The lamp transformer and control panel with its relays are contained in a small case, and the instrument with its accessories in a larger case. They are light enough to be carried as baggage and require only the ordinary careful handling one would give a good quality camera. There are no fragile parts that might easily become out of adjustment.

A brief review of previous work in laryngeal, bronchial and esophageal photography seems indicated. Pressman and Hinman[7], in an extensive survey, have reviewed the literature regarding laryngeal photography. Since their review, however, a notable advance in the technique of indirect laryngeal cinematography has been made by Clerf[8]. The work of McGibbon[9] is the first discussion of endobronchial photography in the medical literature. He describes a technique which permits black and white photography of the bifurcation of the trachea, but is unable to reach the landmarks of the main bronchi. Hull[10], however, has photographed the bronchi beyond the bifurcation using the oblique telescope of a peritoneoscope. Using black and white stills, his exposures ranged up to one second.

With the equipment herein described, the landmarks of the bronchi are easily identified as the bronchoscope is introduced or withdrawn while filming, and each structure is shown in order, in a continuous movement of the instrument. The deepest points photographed are the orifices of the multiple divisions of the lower lobe bronchi of both sides. The carina at the bifurcation of the trachea and the openings of the upper lobe bronchi can, of course, be seen easily. As the scope is withdrawn slowly, the slightly changing angular displacement of the axis of the lumen beyond the tip of the scope creates a sense of perspective. This is true in the esophagus as well, where the photographic esophagoscope practically reaches the stomach.

[7] Pressman, J. J. and Hinman, A., Further Advances in the Technique of Laryngeal Photography. Laryngoscope, 50:535-536, June, 1940. (With this is a very complete bibliography.)

[8] Clerf, Louis H., Photographic Study of the Larynx by Mirror Laryngoscopy, Archives of Otolaryngoscopy, 33:378, March, 1941.

[9] McGibbon, J. E. G., Cinebroncography (Cinematography through the Bronchoscope), Lancet, 1:1083, June 15, 1940.

[10] Hull, Wayne M., Endoscopic Photography, Jour. Biol. Photo. Assn., 9:59-72, December, 1940.

In Memoriam

BRUCE MAYNE, M.D.

Bruce Mayne, Special Expert, Malaria Investigations, U. S. Public Health Service, and a long-standing active member of the B.P.A., died April 30, 1941, at the age of 58. With his passing, the field of entomology lost a distinguished worker.

Doctor Mayne was born in London, England, 1882. He came to this country as a youth and later became a naturalized citizen. He received the B.S. degree from the University of California in 1908 and the M.S. degree in 1910. There he was one of the first students of Professor William B. Herms, under whose influence his groundwork in medical entomology was laid. Later, at the London School of Tropical Medicine, Doctor Mayne received a Certificate of Tropical Medicine, and in 1925 the Doctor of Public Health degree at the University of Georgia Medical School.

Even before he left the University of California, he began to contribute to the field of medical entomology by his association with the study of the San Francisco plague epidemic.

Working in the Philippine Islands, in 1912, he helped clear up the puzzle of the transmission of surra by showing that it could be transmitted by *Tabanus.*

Before and after his work in the Philippines, Doctor Mayne was associated with the U. S. Public Health Service, where he became interested in the role of insects in the transmission of malaria. Working in this field he helped to clarify the question of American anopheline hosts for malaria. One of the most interesting results was the evidence he found demonstrating that man was the winter carrier of malaria organisms instead of the hibernating mosquito.

His work on malaria finally led him to India, where from 1926 to 1929 he was malariologist for the malaria survey of the Imperial Government of India.

Upon his return to this country and the U. S. Public Health Service work, he was instrumental in establishing and directing the work of its malaria research station at the South Carolina State Hospital, Columbia, South Carolina. Here investigations were carried on with malaria and its use in the treatment of general paralysis of the insane. A strain of *Plasmodium malariae* (quartan malaria) was established in 1931 and has been studied continuously for its biology and its use as a therapeutic agent. This strain is now being widely used in mental hospitals at many points in the United States and constitutes one of the most reliable sources for therapeutic malaria. Of particular importance among the researches at that station, was the development of the technique of injecting malaria spotozoites intravenously to produce the infection in paretics. He developed a culture medium for holding viable sporozoites and shipped them by mail to the most distant portions of the United States and even carried a culture to the Epsom Hospital in England. Doctor Mayne served as director of the laboratory until his death.

During the 28-year period in which Doctor Mayne served in the U. S. Public Health Service, he was associated from time to time with various aspects of diseases transmitted by insects. In 1921, he and Dr. E. Francis reported the experimental transmission of tularemia by *Chrysops.* While working with tularemia, he became accidentally infected with this virus and contracted the disease.

In 1933, he worked with Doctors L. L. Williams, Jr., and J. P. Leake in the St. Louis encephalitis epidemic. These scientists tested the theory of encephalitis transmission by mosquitoes on themselves, on convicts and on mice, but found no evidence that mosquitoes were the vectors.

Late in the year 1939, he was sent to Burma and Southwest China as a member of a special mission composed of experts on the control of malaria. Early in January, 1940, it was noticed that he was feeling badly and losing weight. On arrival at Rangoon, Burma, he was found incapacitated because of severe abdominal pains. He was placed under the care of Colonel Morrison (I.M.S.) who made a tentative diagnosis of early peptic ulcer. A short time after this, Colonel Morrison made a diagnosis of malignancy of the stomach. Doctor Mayne wished to return to the United States for operation, and was returned to the U. S. Marine Hospital, Baltimore, Maryland, from China by Clipper plane. Soon after arrival in Baltimore, at operation, he was found to have well advanced cancer of the stomach.

He was a member of a number of societies, such as the American Association for the Advancement of Science, the Biological Photographic Association, the American Society of Tropical Medicine, the Royal Society of Tropical Medicine and Hygiene of London, and the Royal Entomological Society of London. For a number of years he served as Associate Editor of the "Revista di Malariologia."

In recognition of his work in medical entomology, Doctor Mayne was designated as an official representative of the U. S. Public Health Service to the International Congress of Entomology at Madrid, Spain, in 1935. In 1938, he was a delegate to the Third International Congress of Tropical Medicine and Malaria in Amsterdam.

Doctor Mayne had, as a lifelong hobby, the pursuit of photography. As a result of his interest in this field, he has contributed some of the outstanding photographs of parasites and insects, some of which are reproduced in standard textbooks. During his span of investigative work, Doctor Mayne contributed in the neighborhood of 70 papers to scientific journals.

In his death, the field of medical entomology, particularly malariology, lost a critical and inquiring mind which had helped solve some of the basic problems of the role of insects in disease.

MAX BROEDEL

Max Broedel, 71, recognized as the founder of the art of medical illustration in this country, died October 26th at the Johns Hopkins Hospital after several weeks of illness. Mr. Broedel trained many of the medical illustrators of the day and established the first department of its kind at Hopkins. He was one of the few remaining men at Hopkins associated with the "big four" at the institution — Osler, Welch, Halstead and Kelly.

Mr. Broedel became anatomical artist at the Hopkins Medical School in 1894, was made associate professor of art as applied to medicine in 1911 and retired in June, 1940. He illustrated for Dr. Howard A. Kelly, of Hopkins, a book on operative gynecology which was said to have revolutionized the practice of that branch of medicine. Born in Germany, Mr. Broedel was educated at the University of Leipzig.

News From the Trade

Eastman Kodak Company presents prints in full color.

Kodak Minicolor Prints and Kotavachrome Professional Prints are now available from Kodachrome transparencies. The Minicolor Prints are made in two sizes from either 35 mm. or Kodak Bantam Kodachrome transparencies. The "2X" size is about 2¼ x 3¼ inches, and the "5X" is 5⅜ x 7 4/5 inches. Kotavachrome Professional Prints are made from Professional Type Kodachrome Film transparencies from 8 x 10 inches up to 30 x 40 inches in the standard photographic sizes. Nothing smaller than 8 x 10 inches is made from the Professional Type Kodachrome. Color prints of both types depend for color and sharpness upon the original transparency. If the transparency projects well, it will print well. These prints contain dyes which are as stable as possible, consistent with their other requirements. However, prolonged exposure to bright daylight, and particularly to direct sunlight should be avoided. Transparencies which are to be used for Minicolor Prints and should be in the standard 2 x 2 mounts. Further information on these color prints may be had from your nearest Eastman Kodak Dealer.

Agfa Ansco Announced High-Speed Twin-Eight Film.

Twin-Eight Triple S. Pan Reversible — the fastest film available for users of Double-8 mm. cameras — has just been introduced by Agfa Ansco. Three to four times faster than Twin-Eight Hypan, the new film will be welcomed by users of Double-8 mm. cameras for the greatly increased subject range it provides. Twin-Eight Triple S Pan can be used for both indoor and outdoor, day or night scenes, and is especially recommended for action shots or interiors where lighting conditions are unfavorable. In addition to balanced panchromatic color sensitivity, the new material provides fine grain and brilliant gradation essential for superior 8 mm. projection work. Protection against halation is afforded by an exclusive brown silver-coating between the emulsion and the base, which is removed during processing. A lavender-tint base aids in giving the film excellent projection quality. The new film offers wide latitude to compensate for inadvertent misjudgement of exposure as well as good resolving power to insure clear and sharp results. It is supplied in 25-foot spools (50 feet of 8 mm. film), which may be processed at any authorized Agfa Ansco laboratory.

Mansfield Photo Research Laboratories Announce New Shortstop Bath.

"SIGNAL" the Indicating Shortstop, is a revolutionary new photographic solution announced by Mansfield Photo Research Laboratories,

Chicago, Illinois. This new shortstop bath, colorless when fresh, turns rose-red when exhausted. The working bath is free of unpleasant odor. In addition, SIGNAL (undiluted) may be substituted for 29% Acetic Acid in exactly the same proportion as called for in any photographic solution. SIGNAL avoids streaked, stained and ruined prints caused by a worn-out stopbath and provided the utmost in economy as a bath may be used again and again until the red warning color appears. SIGNAL used as an intermediate bath between the developer and fix doubles the useful life of the hypo. SIGNAL does not contain Acetic Acid and being stable, keeps equally well in concentrated or diluted forms. Each 16 ounce bottle makes 20 one pint baths.

News from Wabash Photolamp Corp.

Welcome news to flash photographers are the new list price reductions in the Wabash Superflash line recently announced by Mr. A. M. Parker, President of Wabash Photolamp Corporation. Most important reduction is the new 11c list price of the midget bayonet base Press 25, dropped from 15c. This teams the midget bulb with the smallest standard size flash bulb, the No. 0, as two 11c flash bulbs that have power and punch to cover almost 95% of the average amateur picture-taking requirements. Also reduced is the Blackout Superflash from 60c to 50c list.

A new Wabash Exposure Bulletin brought up-to-date as of October 1st, lists all of the new Wabash flash and flood bulbs for color, the new Blackout Superflash, and all other Wabash photolamps. Complete exposure data on their use with all available films for black and white and color flash photography, is included. The new Bulletin, No. 740P, can be had by writing the Wabash Photolamp Corp., Brooklyn, N. Y.

News from E. Leitz, Inc.

A new synchronized flash unit for the Leica Camera, known as the Model VII Synchronized Flash Unit, is introduced by E. Leitz, Inc. Synchronization is accomplished directly through the shutter mechanism. As the shutter is released, the lamp is flashed at the proper moment. This new unit is composed of two main parts; a special baseplate which is interchanged with the regular baseplate of the Leica, and a battery case with lamp socket and reflector. The synchronizing mechanism is incorporated in the special baseplate.

Other features of the Model VII Leica Synchronized Flash Unit include a test lamp, a bayonet lock on the battery case for quick interchange of batteries, an adjustable reflector, and an extra outlet for firing one or more additional lamps.

Association News

The B P A

GETS OUT A JOURNAL
CIRCULATES ALBUMS AND PRINTS
EXHIBITS AT SCIENTIFIC MEETINGS
PASSES IDEAS ALONG

And the B.P.A. wants your work. Send us 5 x 7 unmounted glossy prints. We can use them for our albums and our exhibition panels. Any print or group of prints that conveys a fact — even an elementary fact — about biological photography can be useful. Send comparison prints, right-and-wrongs, follow-ups, experiments. Put your work into pictures, or into print. Be more than a one-institution photographer. Be a B.P.A. photographer. We are a pioneer group. There is no other organization anywhere studying photography applied to biology and medicine. Here is a wide open field that can be correlated and made infinitely useful. Right now it is an uneven field. Some of us lack recognition; we lack the opportunity to do work we feel should be done. All the more reason to keep together, to pitch in and to explore in every direction. Pictures are valuable. Science has not even begun to use them to their full extent. It is up to us as individuals to develop new uses; it is up to us as an organization to make those uses known. Write us, work with us, criticize us if you like, but be actively one of us. Send us your work. Don't just mean to send it — send it! It will be a step forward for everyone.

ANNE SHIRAS, *Secretary*
University Office, Magee Hospital
Pittsburgh, Pa.

EXCERPTS FROM THE BUFFALO CONVENTION

The Journal. In his report on Journal affairs, Mr. Massopust, the editor, stated that we now have among our subscribers 109 libraries and scientific institutions.

The Army. The questionnaires filled out by our members regarding their qualifications for army medical photography are on file in the Army Medical Museum. At present there is no position or organization in which the Medical Department can use medical illustrators, and, therefore, no way of specifically enlisting for service in medical photography. Nor is the Medical Department planning any course in specialized photography at present. Our canvass of B.P.A. members was intended to inform the Surgeon General and the Army Medical Museum as to those

who are already trained and available for this work. When and if positions are created in the Medical Department or the Sanitary Corps, we will report to our members as soon as possible.

B.P.A. Exhibits. A full fall schedule was planned for our exhibit panels, Traveling Salon, and Albums. Materials was chosen for our three Association exhibits to be held at the meeting of the American Academy of Ophthalmologists and Otolaryngologists in Chicago, the Photographic Society of America show also in Chicago, and the Pennsylvania State Medical meeting in Pittsburgh. Individual members also put in requests for the Salon and the loan albums.

1942 Convention City. Invitations were extended from representatives of three cities — Chicago, Cincinnati, and New York. If we went to Cincinnati or New York, we would probably meet at our usual time in September. If we went to Chicago, we might meet in September, or we might advance our meeting to coincide with the big meeting of the Photographer's Association of America in August at the Hotel Stevens. A tentative vote was taken and was found to be pretty evenly divided among the three cities. The Directors, who must make the final decision in the next few weeks, would like their choice to represent the majority opinion of the members and invite anyone with a decided preference to send in their vote and their reasons for so voting.

1941 SALON

Prints from the following exhibitors were accepted for the Salon:

John A. Bledsoe
Dept. of Medical Art
College of Medicine
Cincinnati, Ohio

Lardner A. Coffey
Mayo Clinic
Rochester, Minnesota

Jocelyn Crane
Zoological Park
Bronx, New York

C. Graham Eddy
Eloise, Michigan

Lydia C. Eskridge
Warner Institute of
Theropeutic Research
New York, New York

Fleischman Laboratories
810 Grand Concourse
New York, New York

Ferdinand R. Harding
Children's Hospital
Boston, Massachusetts

Alexander Hellwig, M.D.
St. Francis Hospital
Wichita, Kansas

Nathan S. Horton
Ayerst, McKenna & Harrison
Montreal, Canada

Leonard A. Julin
Mayo Clinic
Rochester, Minnesota

E. B. Mains
University of Michigan
Ann Arbor, Michigan

Adolph Marfaing
Columbia University
New York, New York

Leo C. Massopust
Marquette University
Milwaukee, Wisconsin

Stanley J. McComb
Mayo Clinic
Rochester, Minnesota

Henry W. Morris
University of Minnesota
Minneapolis, Minnesota

William F. Payne
Buffalo, New York

Leonard Perskie
Defender Company
New York, New York

Albert Reisser
384 Walnut Street
Buffalo, New York

Frank N. Ruslander
Harper Hospital
Detroit, Michigan

Albert Sadler
St. Vincent Hospital
New York, New York

Louis Schmidt
Rockefeller Institute for
Medical Research
New York, New York

Dr. Silverman
Queens General Hospital
New York, New York

Irvin Carson Young
Haloid Company
Rochester, New York

Stella Zimmer
Syracuse University
Syracuse, New York

August S. Zorn
Eloise Hospital
Eloise, Michigan

Charles E. Simmons
Buffalo Museum of Science
Buffalo, New York

A correlation of all data indicates that a total of 124 prints were submitted out of which 83 were accepted and hung. In addition to these 83 prints, loan exhibits totalled 47 bringing the total number of prints hung to 130. Generally speaking, the Salon, as a scientific photographic exhibit, did credit to the Association, but it is most disheartening to record that out of our total membership only about 21 submitted prints.

NATHAN S. HORTON
Ayerst, McKenna & Harrison
Montreal, Canada

EXHIBIT OF MEDICAL PHOTOGRAPHY

sponsored by

THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION, INC.

at the Congress of the American Academy
of Ophthalmology and Otolaryngology
Palmer House, Chicago, Illinois
October 19-23, 1941

The Exhibit: From the prints sent us, we assembled an exhibit consisting of one panel each of examples of eye photography, oral and laryngeal pictures, photomicrography, cultures, and clinical photography. We made use of the two panels dealing with our survey on biological photography and with the Journal. When planning our panels we found that we could make use of many of the prints that were used at the A.M.A. exhibit. These we left in place. We did, however, remove all pictures of apparatus from the panels because we felt that the space could be better utilized by showing the product rather than the tool. All pictures of apparatus designed for endoscopic photography, together with examples of work done with this equipment, were put into one album. A second album was filled with other interesting photographs. Both of these albums occasioned a good deal of favorable comments. In addition to the above mentioned panels, two transparency illuminators were fitted to hold 21 Kodachromes of eye, nose and mouth lesions.

Attendance and Results: On the whole, we enjoyed a good attendance at our booth throughout the whole convention, although, as could be expected, the largest number of contacts were made in the interim between the scientific sessions. A great many consultations were held with the visitors relative to their photographic problems, the largest number of which were concerned with the best equipment to use for a given problem. In these instances, our album served us admirably since it made it possible for us to show them what had been developed along these lines. Our photographic print exhibit also came in for a good deal of scrutiny and it is our feeling that the exhibit was well received by most of the convention visitors. This was also borne out by the statement of the Convention Chairman, Dr. O. E. Van Alyea, to the effect that he had heard much favorable comment relative to our exhibit and that he hoped we might exhibit again.

Five members of the Chicago Chapter alternated in attending the booth, as well as in hanging and dismantling the exhibit.

Yours, for the Chicago Chapter,

WM. L. M. MARTINSEN, *Chairman.*

OTHER EXHIBITS

The material prepared for our booth at the Pennsylvania State Medical Meeting was never shown because six days before the opening date a strike was called among hotel employees and all Pittsburgh's leading hotels shut down for 15 days. The meeting is scheduled to be held in Pittsburgh next fall and this year's exhibitors will be invited to take space again at that time.

The exhibit of the Photographic Society of America, to which we contributed a section of prints, is still being held in Chicago as this goes to press. A report will be published later.

BACK NUMBERS NEEDED

The B.P.A. needs certain back numbers of the Journal to round out complete sets for sale to new members and subscribers. Many requests come in for complete Journal sets, and their sale contributes to the support of the Association. If we can fill up the gaps listed below, we can continue to furnish complete sets for a limited time, but without these we can fill no further orders. If you have any duplicates of copies listed, or if you know anyone who has them and no longer wants them, you will be making a real contribution by sending them in. We are authorized by the Board to offer up to 50c apiece for the specific copies listed below.

Vol. IV —No. 1 (September, 1935)
No. 2 (December, 1935)
No. 3 (March, 1936)
Vol. V —No. 1 (September, 1936)
No. 3 (March, 1937)
No. 4 (June, 1937)
Vol. VI —No. 1 (September, 1937)
No. 3 (March, 1938)
Vol. VIII—No. 2 (December, 1939)

Please send your Journals to:

MR. LOUIS SCHMIDT
Rockefeller Institute for Medical Research
New York, N. Y.

AMERICAN FILM CENTER HEALTH EDUCATION

The establishment of a section on films in health education and medicine at the American Film Center was announced early in October by Donald Slesinger, Director of the Center, at its office, 45 Rockefeller Plaza, New York City. Adolph Nichtenhauser, M.D., is in charge of the section. The new section will be a clearing house and information center on the use and production of health education and medical films.

CENTRALIZED MEDICAL PHOTOGRAPHY AT GALVESTON

Robert A. Sage, an active member of the B.P.A., has left Baylor University to take charge of the department of medical photography at the University of Texas at Galveston. Many of the departments of the University's Medical Branch use photography, and an effort will now be made to centralize this work under one main photographic department. This work of centralization is one that is badly needed in many institutions and we hope Mr. Sage will send us a report on the workings of his department after it gets into full swing. We publish his summary of the volume of work used by medical departments at the University for the year ending June 14, 1940, as a number of members may be interested in comparing it with the work of their own institutions:

Negatives — 2,148 — (Surgery 1,822)
Prints — 3,852 — (Surgery 2,285)
Slides — 973 — (Surgery 564)
Slide negatives — 861 — (negatives for lantern slides made on 3¼" x 4" plates) (Surgery 481)
Enlargements — 426 — (Surgery 376)
Movies — 5,400 ft. — (Surgery 4,295 ft.)

CONGENITAL ANOMALIES

JACOB SARNOFF

(400 feet, monochrome, silent)

Living children are shown with the following anomalies: meningoencephalocele, spina bifida, imperforate anus, exstrophy of the bladder, club-foot, pseudo-hermaphroditism, hypospadias, exstrophy of liver, spleen and intestine, Hirschsprung's disease, supernumerary digit, harelip, and two unlabelled anomalies, one apparently an esophageal obstruction and the other some form of small mouth tumor. The various anomalies are well shown, and the film should be useful as a supplement to a course in human embryology or pathology in which congenital anomalies have been studied. The effectiveness of the film would be improved by descriptive legends, or better still by the addition of a sound-track.

ELIOT R. CLARK.

REPORT OF THE COMMITTEE ON MOTION PICTURES*

A. *Films by Members of the Biological Photographic Association 1941.*

Amyot, Dr. L. B., *Labrador Adventure.* 16 mm. Taken while dental officer of the Grenfell Medical Association.

Armstrong, H. Burnett, *Manometric Measurements of Pressures in Lung Cavities.* A 16 mm. color movie for Dr. Leo Eldesser, San Francisco, California.

Futterman, Dr. M. J., *Dental Anomalies Connected with Pseudo-hypertrophic Muscular Dystrophy.* 350 ft. Kodachrome.

Hooker, Dr. Davenport, *Premature Infant Behavior.*

Lown, Wilbour Chace,
Drawing Techniques. 800 ft. black and white.
Alveolar plasty. 400 ft. color
Tracheaectomy. 400 ft. color.

Palmer, Vincent, *New Worlds under Sea.* Underwater color film of men and sea creatures.

Roger, Henry, *Studies in Human Fertility.* For Johnson and Johnson and Audio.

B. *Catalog of Films.*

Medical Film Guild, Joseph P. Hackel, 144 East 57th St., New York City. Medical films and equipment.

C. *Rutgers Films.*

Dept. of Biophotography, Rutgers University, New Brunswick, New Jersey. Catalog No. 4, 1941. Lists 25 films on biology, surgery and child study.

D. *Film Depository of the Wistar Institute of Anatomy and Biology, Philadelphia, Pa.*

Published in the Anatomical Record, Reviews of Approved Films in Anatomy and Biology, May, June, July and August, 1941, contains 17 critical reviews of biological films.

E. *Literature.*

Roger, H., *Science and the Motion Picture.* J.S.M.P.E., Feb. 1940, p. 193.

Stone, C. H., Valentine, W. L. and Miles, W., *The Production of 16 mm. Motion Picture Films.* Psych. Bull., 1940, 37:29-59.

(Prepared under the auspices of the committee on the use of motion pictures and sound recording devices of the American Psychological Association.)

OSCAR W. RICHARDS, *Chairman*
19 Doat St., Buffalo, N. Y.
K. K. BOSSE
JEAN KIEFFER

* Received for publication October 14, 1941.

Forestry

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LEO C. MASSOPUST,
EDITOR

For the advancement of photography in relation to the biological sciences.

Published Quarterly For The
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Waukesha, Wisconsin

OFFICIAL PUBLICATION OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION

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Official Publication of the Biological Photographic Association

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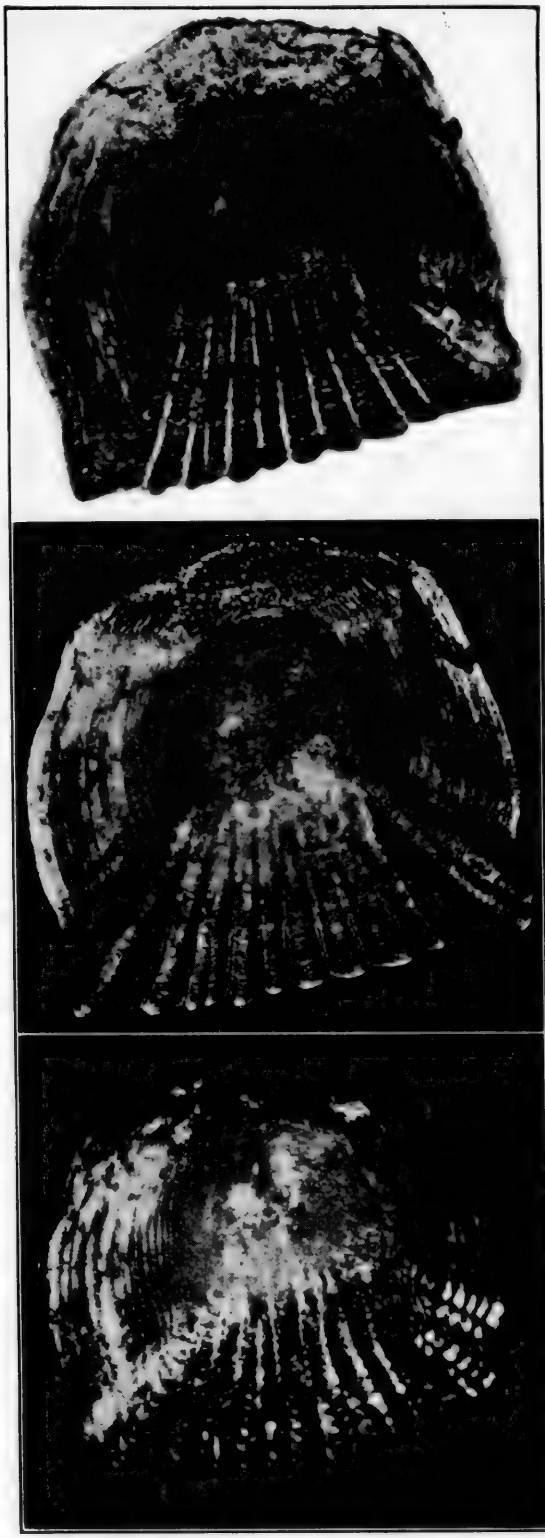

Figure 3. Fish scales photographed: a. with bright field, b. dark field and c. polarized dark field illumination. (CF. text and figure 2). 10X.

Photomicrographic Notes*

by Oscar W. Richards†

I

THE finest details revealed by the microscope may be photographed with apochromatic lenses of large numerical aperture, but the objectives have less depth of focus as the aperture increases. For optical sectioning, the least depth of focus is desirable. Frequently the photomicrograph is expected to show considerable depth. The most useful compromise is an objective with just enough resolution to separate the detail required in the photomicrograph. Up to magnifications that fail to show increased detail, it may be preferable to use a lower power objective and a strong (15 or 20 X) eyepiece to obtain the desired size, rather than a high power objective of greater magnification and little depth of focus. The considerable choice of objectives and eyepieces available usually makes possible a suitable compromise. The futility of empty magnification is shown in figure 1. Each picture is magnified to the same size; the detail on the long chromosome shows only when taken with an high aperture lens (c) and the picture made with the low power objective (a) is fuzzy from lack of resolved detail.

II

Translucent and semitransparent objects frequently reveal more detail with dark field illumination. Fine, bright detail contrasts with a dark background and is easier seen and photographed than the same detail against a bright background. The excellent dark field condensers available for use with the microscope have rather limited area and cannot cover medium sized objects. Fish scales could be examined to advantage with a suitable dark field method.[1] By blocking the central 80 per cent of the diameter of the Spencer Universal Lamp, figure 2, and placing the fish scale at the point where the rays cross, the scale appears brightly self-luminous against the black stop. Black photographic paper may be used for a temporary stop and the size required is readily found by trial. The increased detail disclosed by the dark field method is shown in figure 3.

* An abstract of a paper presented at the Annual Convention of the Biological Photographic Association in Buffalo, New York, September 11, 1941.

† Research Biologist, Spencer Lens Co., Buffalo, New York.

[1] I am indebted to Mr. A. L. Smith (Cornell University) for proposing this interesting problem.

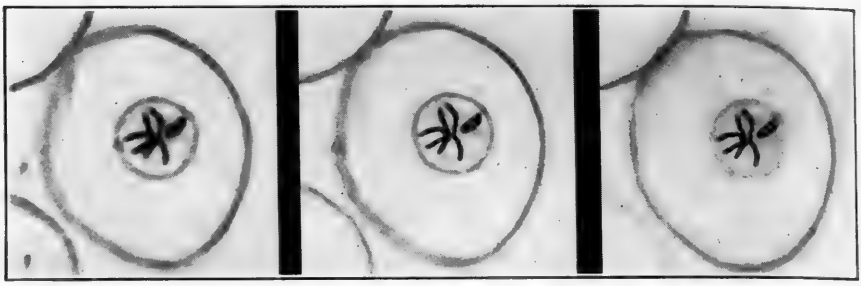

*Figure 1. Chromosomes of Ascarais at metaphase magnified to 160 X and taken with: A. 16 mm. N.A. 0.25 objective; B. 4 mm. N.A. 0.66; and 2 mm. N.A. 1.30 objective. (**Cf.** text.)*

The material added in layers to the base of the scale as the fish grows is birefringent and shows bright colors in polarized light. A disc of Polaroid H was placed over the lamp and another placed over the scale. The latter was rotated until the field was dark and the interference colors of the scale brightest. The picture, figure 3c, indicates the appearance in polarized, dark field illumination, in the inadequate way that black and white records colors. This method makes possible the dark field illumination of medium sized objects with inexpensive equipment. The light is not focused as sharply as with a good dark field, microscopic condenser, but is adequate for moderate sized specimens.

III

The development of a fluorescent technic for the identification of tuberculosis and other acid fast bacteria[2] required a photograph of the bright yellow bacteria as seen against a dark field. The bacteria were treated with carbolauramin and the dye removed with a destaining solution from all but the bacteria. When the auramin stained bacteria are exposed to ultraviolet radiation, they fluoresce bright yellow. The contrast between the bacteria and the background is so great as to make the method more sensitive than the methods heretofore used. This contrast is misleading when photographs are to be taken. Instead of an exposure of about a fiftieth of a second, as one trained photographer guessed, it took from one and a half to two minutes on superpan press film at a magnification of about 400 X. The blue ultraviolet transmitting filter of the lamp filtered out most of the visual light and a yellow filter in the eyepiece prevented any ultraviolet from reaching and fogging the film.

[2] Richards, O. W., Kline, E. K., and Leach, R .E., Demonstration of Tubercle Bacilli by Fluorescence Microscopy. **Am Rev. Tuberc.,** 1941, 44:255-266.

In answer to questions during discussion, it was pointed out that an intense source of ultraviolet is required for general fluorescence photomicrography equipped with a filter to remove the visual light and a protective filter must be placed between the specimen and the plate or film to absorb the ultraviolet. Fast materials are necessary to record the weak energy of the fluorescent image; and in some cases the fluorescence is transient and may not be enough for a good picture, especially when color processes are used.

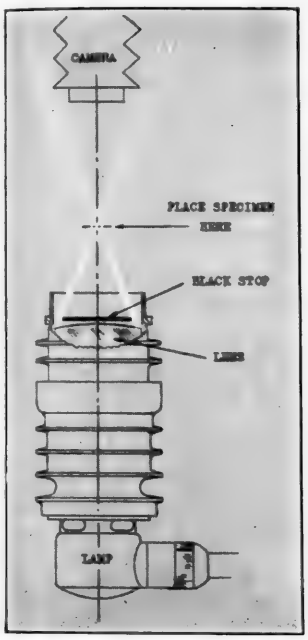

Figure 2. Arrangement of dark stop on lamp and object for dark field illumination of fish scales and other medium sized objects.

IV

The negatively charged particles, called electrons, were discovered by Thompson during the latter part of the nineteenth century. Shortly after their discovery, de Broglie predicted that they would behave like light. Electron optics were systematized by Busch and have been applied practically in television and the electron microscope.

The simplest electron microscope is a glass sphere with a source of electrons (hot wire filament) at the center, a fluorescent material on the glass to show the shadows produced by the invisible electrons, a potential difference between the source and the glass to force the electrons to the fluorescent screen and the removal of the air from the sphere so that the movement of the electrons would not be disturbed. Such an instrument is used to study the details of the material composing the filament source of the electrons. Magnifications of 10^5 have been used and a resolving power of 1μ attained.

A magnetic or electrostatic field will influence the path of electrons in a manner similar to the way light is refracted by glass lenses. The compound electron microscope is constructed with magnetic fields corresponding in position and function to the lens systems in the compound light microscope. The electrons emitted from a source are focused onto the specimen by the first field. After passing through the specimen, an enlarged image is formed by the second magnetic field and a third field magnifies this image to give an enlarged shadow image on a fluorescent

screen or on a photographic plate. The entire instrument must be evacuated and locks supplied for bringing the specimen and plate into the microscope without lowering the vacuum.

The specimen is mounted on a very thin layer of collodion supported on a fine screen and is usually smaller than 0.3 mm. Glass slides and other material not transparent to electrons cannot be used. Likewise the specimen must be able to withstand drying in the evacuated microscope. The electrical controls must be sensitive so that the aberrations be kept to a minimum. Greater or less magnification and focusing is accomplished by changing the magnetic density of the fields.

The short wave length of the electron particles as compared to light makes possible greater resolution and higher magnification. The electron photomicrographs are taken on ordinary lantern slide plates with exposures of 10 to 25 seconds and at magnifications up to about 30,000 diameters. Subsequent enlargement of the negative to 100,000 X is possible. The commercially produced RCA electron microscopes have an advertised resolving power of 5 mμ which is about one twentieth that of the light microscope. Special electron microscopes have been used with resolutions about twenty times greater than this. Through the kindness of Mr. Theodore A. Smith, Engineering Products Division of RCA Manufacturing Company, I was able to show lantern slides of bacteria and other objects taken with their electron microscopes.[3] Other slides illustrated European instruments.[4]

[3] Many of these pictures are to be found in the excellent booklet, "Into Unseen Worlds" distributed on request to Mr. T. A. Smith, RCA Manufacturing Co., Camden, N. J.

[4] Since space prevents giving further details in this report, the interested reader may use the following sources for further information on the electron microscope.

Becker, J. A., and Ahearn, A. J., Electron Microscopes and Their Uses. **Sci. Mon.,** 1941, 53:309-324.

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Photographing the Plantar Surface of the Feet With Weight Bearing*

by F. R. Harding†

FOR some time past it has been possible to photograph the front, back, lateral, medial aspects of the feet, and also the top of the forefoot by routine methods, but photographing the plantar surface has not been deemed routinely possible. The apparatus about to be described makes it a comparatively simple routine.

The apparatus, figure 1, is very simple, inexpensive, and may be constructed easily. It consists of a metal stand, the dimensions of which are: length 18 inches, width 14 inches, height 18 inches. Of the dimensions given, the height of the apparatus is the only one which is critical. For adult patients, three or four inches larger in all other dimensions would be of advantage.

Figure 1. Apparatus for photographing the plantar aspect of the feet.

A section of plate glass one half inch thick is placed on top of the stand. The dimensions of the glass are 16 inches by 20 inches. All corners are rounded and all sharp edges are beveled or ground off. The glass should be kept in a flannel bag when it is not in use to prevent the formation of scratches. Two small tapered holes are bored part way through the glass, one on the right and one on the left. Small metal pegs fit loosely into these holes, the pegs being welded to the inside of the top frame. The glass must rest solidly on all four sides of the frame, and not be balanced on the

* Presented at the Annual Convention of the Biological Photographic Association in Buffalo, New York, September 12, 1941.

† Childrens Hospital, Boston, Mass.

two pegs, or the glass will split when a heavy weight is applied. The pegs are to prevent any shift of the glass after it is placed on top of the stand. Halfway between the top and bottom of the stand, a pivoted mirror is inserted. The pivots are at the right and left sides of the apparatus. Natural choice would indicate a surface mirror, but due to the difficulty and expense of procuring a surface mirror of such large size, 11 x 15 inches, to say nothing of the task of keeping it untarnished and unscratched, a thin 3/16 inch high grade plate glass mirror is employed and serves very well.

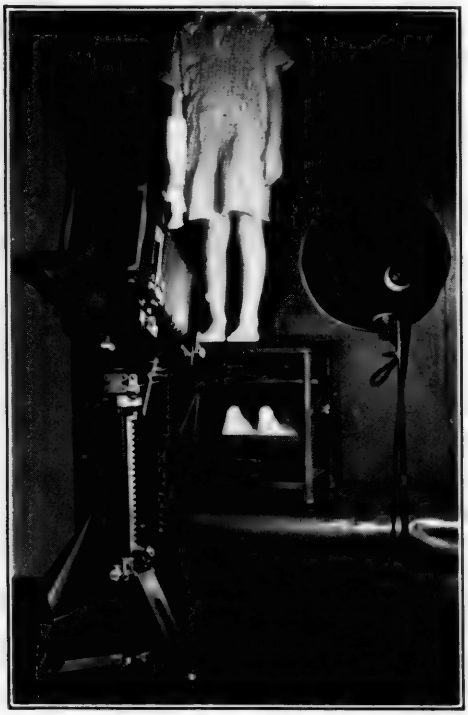

Figure 2. The apparatus in use.

When being used, the apparatus is placed on top of the examining table which is 26 inches high. The patient stands on the glass, facing the camera, and the image reflected in the mirror is photographed (figure 2).

As the image is a reflected one, it is necessary to identify the right and left foot by a small R and L placed on the glass in front of the feet. The sole of the foot should be wiped clean before placing it on the glass. The glass should be carefully cleaned to remove finger and footprints. It should be cleaned with alcohol after being used. The lighting comes from one lamp placed at approximately the ankle height of the patient. Care should be used that the light does not reflect in the mirror, and that shadows of the front legs of the stand do not appear on the mirror. All ceiling lights should be extinguished. The camera is raised and tilted to about the same angle as the mirror. The apparatus should be placed in front of a black background. By changing the mirror angle and the camera height, reflection from the light source may be avoided.

A change of color occurs on the sole of the foot when the patient is standing. The part of the foot bearing the greatest weight becomes greenish yellow. Sections of the foot bearing less weight show some

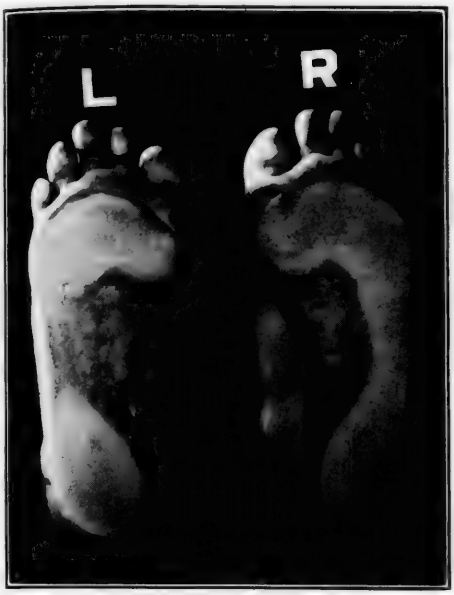

Figure 3. A typical plantar view.

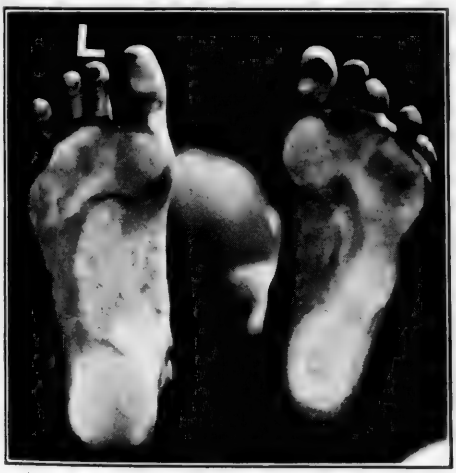

Figure 4. Note the pressure on the cuboid area of the right foot.

slight color change, plus flattening. It is possible to determine from the photograph what parts of the foot are bearing weight and what parts have only skin contact with the glass. This type of photograph is routinely employed on feet in which it is desired to show such deformities as valgus, equinus, cavus, or rocker feet. It is particularly valuable for cases of equinus feet, because it will show exactly the amount of weight bearing on the heel. The plantar view is in addition to the routine Anterior Lateral, and Posterior views. It is necessary for the surgeon to gain some experience in reading the photographs, as this is a totally new viewpoint to him. He must learn to distinguish between heavy weight bearing and skin contact. This is readily apparent after it is once pointed out. Orthochromatic film seems to bring out the color changes with better contrast than panchromatic film. The film emulsion is called upon to produce contrast between the normal skin color and the greenish yellow of heavy weight bearing, the shades of pink color in medium weight bearing, and the flattening of skin contact.

Credit is due to Louis Schmidt for ideas on the use of mirrors in a paper on photographing bacterial cultures, published in the Jour. Biol. Photo. Assn. in 1932, and to an unknown industrial photographer who some years ago produced an advertising photograph showing the bottom of a tired foot.

Sound in Medical Motion Pictures*

by Harris B. Tuttle, A.C.L. and Raymond J. Dwyer†

WITH the many improvements that have been made in 16 mm. film technic, and the extensive use made of the 16 mm. motion picture in teaching, lecturing, and for purposes of study, it is quite natural that some consideration should be given to the possible use of sound in the making of medical motion pictures.

The many advantages of using "off stage" sound commentary with 16 mm. films to describe a certain technic in surgery have long been recognized. Such films are extremely valuable for teaching and for lecture purposes. Too, these films enable the studnet to hear the voice of the surgeon describing the details of an operation of which he is intimately familiar, thus bringing [illegible]re students and medical groups the work of outstanding men in the medical field.

Perhaps less thought has been given to the possible use of sound-films as means of recording defects in speech due to the speaking mechanism or from other causes. Increasing use is being made, however, of the disc phonograph record in studying speech mannerisms and defects, and there is considerable activity in "instantaneous" disc recording apparatus. There has been continued improvement in the apparatus and in the discs themselves, and costs have been brought down to the point where the making of these records does not run into a great outlay. There are possibilities in the use of the "instantaneous" disc and the 16 mm. black-and-white or Kodachrome film in combination and these will be touched on later. It seems, however, that the directly made sound-film offers the best means for purposes of study and record than do other methods.

In the past few years, a number of cases have come to our attention at Strong Memorial Hospital in Rochester, New York, of the type that could best be presented by a sound record as well as a motion picture record, in order to show fully the behavior of the patient. It was decided to make sound motion pictures of two or three of these subjects in Kodachrome, thus combining *color, sound,* and *motion* in one medical motion picture. Several sound motion pictures were also made in black-and-white.

* Presented at the Annual Convention of the Biological Photographic Association in Buffalo, New York, September 12, 1941.

† Eastman Kodak Co., Rochester, New York.

For black-and-white, the 16 mm. Cine-Kodak Safety Reversal sound film, and for color 16 mm. Cine-Kodak Kodachrome Type A sound film were used. In the making of these several subjects, four No. 1 photo-flood lamps, four feet from the subject, were used with a lens aperture of f:6.3 for the black-and-white and f:4.5 for Kodachrome. The pictures were made at the standard sound speed of 24 frames per second.

Outlines of the case histories were prepared by the attending physician and committed more or less to memory. Close-ups were made of the doctors as they presented the outline of the case history. Near the end of the outline, the camera shifts its view from the doctor to the patient and the doctor's voice continues on, describing the case and directing the patient's action during the filming.

These sound-films were made by the "single system" and it might be well at this point to differentiate between the several methods of sound-film production. In the "single system" method, both picture and sound record are made at the same time on a single film, and the camera is both picture taker and sound recorder unit. The 16 mm. Cine-Kodak films, both black-and-white and Kodachrome, for sound recording, have the perforations along but one side of the film, the sound record being made on the other side in the space that is normally used for perforations in silent films. After exposure, the film is sent to the processing laboratory and it comes back to the owner ready for showing in a 16 mm. sound-on-film projector.

The "double system" method means simply that two separate films are used, the one for the picture purposes, and the other for the sound record. The camera is operated at 24 frames per second, generally by a synchronous electric motor, and the film, either black-and-white or Kodachrome, can be the regular both-sides-perforated type. The separate sound track recorder is also motor-driven and it exposes the film at a rate corresponding to 24 frames per second, or 36 feet per minute. The film used in the sound track recorder is of special characteristics, designed to provide sound records of top quality. It is necessary, of course, that both camera and recorder operate in synchronization. This is taken care of by using either synchronous motors or electrical interlock motors. Various methods are used to mark the beginning of the picture and the sound track for each "take." These need not be detailed here.

In the "double system," the separate picture and sound track films are but the means to the end. The processed films are edited and it is, of course, necessary to cut the sound track film to correspond to the picture parts where direct synchronization is necessary. The edited picture film and its companion sound track film are now sent to the processing

laboratory for the making of the composite duplicate, which will have both picture and sound track on the same film. We now have a sound-film ready for showing in a sound-on-film projector, the same as we had when we used the "single system" method. However, the "double system" technic is considerably more flexible than the "single system" and editing can be done much the same as is the case with silent films, as scenes can be changed around, extra shots inserted, diagrams included, and the separate sound track film can be "matched" to the picture. The equipment needed, however, is more elaborate and more expensive than the "single system" unit, and film costs are higher since the cost of a duplicate film is involved. The film used in the sound track recorder is an item, but it is relatively inexpensive. The advantage lies with the "single system" set-up where costs must be watched and a fairly simple method of making sound-films is wanted. It is necessary to evolve a technic that can be used with the "single system" method, and although there are some types of work that cannot be made in this way, there are others that lend themselves very satisfactorily to this treatment. The "double system" is the method employed when sound is "dubbed" or added to a film originally photographed as a silent subject, and this will be discussed later.

In considering the possibilities for the future from the experience gained through these experiments in "single system" sound-films, it can be said that the work should be done in a room that does not allow the entry of outside sound and where the acoustics are favorable. The filming of clinical cases presents no special problems, involving more or less straight-forward motion picture practice plus the extra attention which must be given to the sound recording. However, the filming of some operations by this method might present problems, the solution of which would depend upon the ability and resourcefulness of the medical photographer. Films of this type lend themselves much better to the "double system" where the motion picture part is made as a silent film, and full attention is paid to doing a thorough job of detailed photography. The pictures are photographed at 24 frames per second, and after they are assembled and properly edited, the sound commentary is "dubbed," following the technic already mentioned. As was the case with the making of the picture record, full attention can now be paid to the commentary, and either the operating surgeon or some other authority on the subject can deliver the "offstage" sound.

Mention has been made of possibilities that may exist for the use of the "instantaneous" disc record in combination with the 16 mm. black-and-white or Kodachrome film. A combination of this kind would

be better adapted to adding of commentary to the silent film and could be made after the picture has been edited. There is, however, a very important problem in this sort of combination since there is a matter of synchronization of the film and record to be taken into account. In the early days of the "talkies," the sound-and-disc method was used almost exclusively and projection equipment consisted of the motion picture unit and the turntable device, both driven by a common motor. Both film and record were started at marked spots and they remained "in step" as long as the film did not become damaged. Sixteen-millimeter sound followed much the same course in the beginning and there were a number of 16 mm. sound-disc units. These, like the 35 mm. projectors, had motion picture projector and turntable driven by the same motor. It is quite possible that anyone desiring to make use of this system could obtain one of these projectors in the second-hand market.

Of more recent introduction in the field of film-plus-disc systems, is one put out by a concern[1] of prominence in the "instantaneous" disc recording field. An electrical interlock system is employed for maintaining synchronization between recorder and camera, when making the picture, and the same order of synchronization between projector and playback turntable when reproducing picture and sound. A method involving no direct connection between the projector and the turntable is one where the speed control on the projector is adjusted manually to keep the picture "in step" with the sound. This involves rather accurate timing and calls for the operation of the equipment by someone who is familiar with the subject photographed and described, and with the characteristics of the equipment in use. A refinement of this method is to adapt some sort of indicating means to the projector and use the speed control to maintain the rate of projection at fixed value. One such method is the stroboscopic disc attached to sprocket shaft or shutter shaft on the projector, illuminated by a small neon bulb. When the lines on the disc are properly spaced and illuminated by the pulsations from the neon bulb, they will appear to stand still when the shaft is revolving at the proper speed. Assuming proper timing of the film and record when made, both will remain "in step" once they have been brought to that point.

The simplest method of all of providing the "offstage" commentary for a photographed-as-silent film is to use a microphone in conjunction with a sound-film projector, or with public address equipment. This is not, however, a sound-film in the sense that we have been discussing. The method is somewhat limited in its usefulness since it requires the

[1] Presto Recording Corporation.

presence of a competent speaker and repeated showings of the film become quite a chore.

Unquestionably, when a number of hospitals and medical men become sufficiently interested to engage in further experimentation with the use of sound, the details and problems that exist will be more carefully studied and worked out. We have no doubt that every member of the medical profession, once he becomes familiar with the possibilities of sound, will be able to apply the best method of presentation available for any given case.

The question of quality of sound that can be expected from 16 mm. black-and-white and Kodachrome films is one that is of extreme importance. In the case of medical motion pictures in sound, we are not concerned about the fidelity as it affects music, but it is important that speech sounds be reproduced with complete intelligibility. Of course, if all elements of our recording and reproducing system are of proper characteristics, then we can expect that speech will be completely recognizable if there is fidelity in respect to music. However, in order to make recorded and reproduced speech sounds with as much intelligibility as can be obtained, it is sometimes advisable to modify the characteristics of the equipment to bring about added crispness. These are technical matters which need not concern us here, but on the whole subject of quality it can be said that completely satisfactory results are possible.

On both black-and-white and Kodachrome 16 mm. sound films, proper attention must be paid to all elements in the complete recording and reproducing system, aided by acoustic conditions and the employment of suitable technic. Where all elements that contribute to good quality are present, then we can expect results that will be satisfactory and demonstrate that sound can be an adjunct to picture. If sufficient care has not been taken in the making of the film, then it will be all too evident that the sound is a detriment. This is not at all necessary, and the increasing use of 16 mm. sound films for entertainment shows that we have gone a long way since the first 16 mm. sound film was produced. Obviously, further improvements will come from the continued development of the art, but as of today, it can be said that the time and effort plus good equipment in the making of 16 mm. sound films, either black-and-white or Kodachrome, will "deliver the goods."

A Combined Polarizing Screen and Light Unit

by Lardner A. Coffey*

POLARIZED light has many applications in clinical photography. In photographing wet, gross specimens, the polarizing screen over the lens does not eliminate the disturbing highlights. These reflections can be removed by the addition of a polarizing screen over the source of light. The polarizing screen holder and stand now on the market have been found cumbersome and awkward to use. The holder for the polarizing screen and the light must be used on separate stands, and cannot be used closer to the floor than 48 inches (120 cm.). The unit illustrated was designed to provide an improved method of using a polarizing screen over the source of light (figure 1). This combined polarizing screen and light unit is manipu-

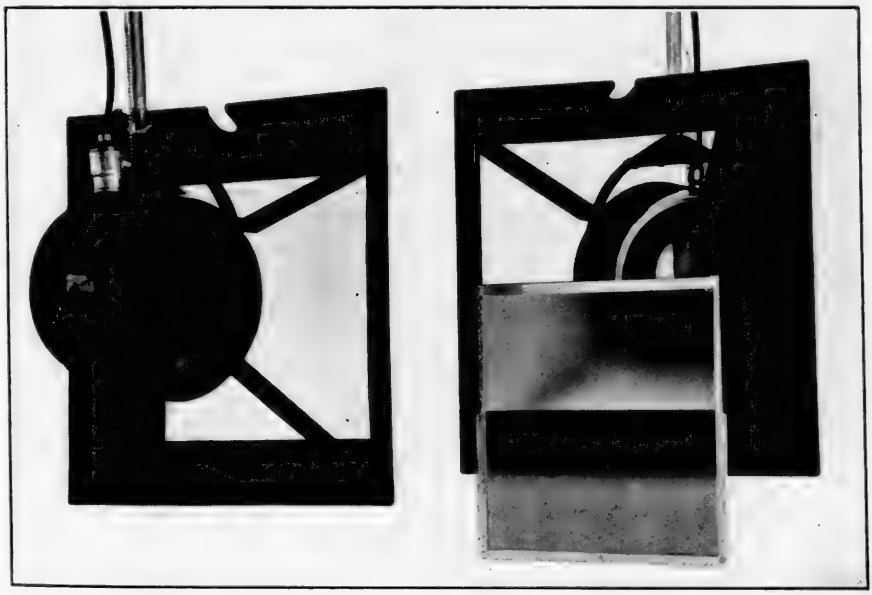

Figure 1. A combined polarizing screen and light unit.

* Received for publication August 29, 1941 from the Photographic Department, Mayo Clinic, Rochester, Minnesota.

lated easily, is durable, is light in weight and allows only polarized light to illuminate the subject.

To a reflector,[1] a metal collar is added to help eliminate stray light; a light shade is attached to the collar, which also serves as the holder for the polarizing screen. The polarizing screen is protected from excessive heat by mounting it 12 inches (30 cm.) from the bulb. As only the light passing through the polarizing screen should illuminate the subject, the extraneous light is eliminated by the collar over the reflector and four flanges assembled to form a square shade and support for the polarizing screen. The flanges are set at about an angle of 45 degrees. The collar overlaps the reflector one inch (2.5 cm.), and an air space is provided between the collar and reflector to give better circulation of air. The bottom braces holding the flanges to the collar are fastened to the lower inside corner of the flanges. This, in addition to the notch in the bottom flange, renders the unit more useful by giving it greater down tilt.

Each part is fastened securely to the other and a U brace fastened to the collar supports the unit on a collapsible tripod. The collapsible stand makes it possible to lower the unit to within 25 inches (63 cm.) of the floor. A wing nut at the point of junction of the collar and brace, holds the unit at any desired angle. This assembly has been found fully satisfactory for clinical photography and other studio use.

A local metal worker constructed the unit of light sheet metal, and to make the apparatus more presentable it was finished with black, baked, crackle paint.

[1] A sun-ray lamp No. 2. A No. 1 photoflood bulb or a 500 watt Mazda bulb may be used in this reflector.

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Practical Lantern-Slide Projection

by John A. Maurer*

SOME years ago I was only mildly concerned about the number and size of letters used in lantern slide material. My first slides succeeded in including many times as much material as could be read by people in the back of the room. Then I read a statement by Gage[1] to the effect that the optimum size of a projected image was one-fourth to one-fifth the distance from the screen to the back of the room. This information set me to thinking about the amount of material which it would be practical to include in projected images under varying conditions. It was obvious that proper makeup of copy for lantern slides is not the entire answer to problems of clarity and legibility. A good lantern slide may be worthless under improper projection conditions. On the other hand proper projection conditions cannot make up for poorly prepared copy. At Loyola University one of the main lecture rooms has a ratio between room depth and screen size (Room Image Factor) of almost seven to one. Lecturers are now advised to hold down their material to a quantity legible at this ratio. All copy[2] is viewed at a distance equal to seven times its greatest dimension, and must be better than barely readable at that distance. It is hoped that this article will help clear up the relationship between original copy preparation and screen visibility for all types of copy.

A relatively simple test for legibility can be applied to all types of copy, if the Room Image Factor mentioned above is known. The procedure is as follows. Measure the copy to see which is the greater dimension, width or height. Multiply the greater dimension by the Image Factor of the projection hall. The result is the distance at which the copy should be viewed to see if it is readable. *It should be easy to read.* Next increase the viewing distance *one and a half to two times,* and study the copy again. In general, with normal eyesight, or the correction known as 20/20 vision,[3] the copy will be quite usable if just decipherable at a distance equal to twice the Room I.F. times the copy size. Thus, if the copy is five inches wide and the Room I.F. is seven, the copy should

* Received for Publication from the Photographic Department, Loyola University School of Medicine, Chicago, Illinois.

[1] Optic Projection. Simon Henry Gage, Henry Phelps Gage. 1914.

[2] Copy. A term often used to designate prepared material ready to be photographed, also often means the photograph of, or act of photographing such material.

[3] Glasses are generally fitted with corrections that will give normal visual acuity to 20/20 vision.

be easily readable at 35 inches, and just decipherable at 70 inches. If the copy passes this test, a person with normal vision will be able to read the projected image from the back of the room without trouble. No one will bother to read material so fine that he can just decipher it, hence the reason for multiplying the Room I.F. by two when testing copy. Of course the person with half normal or 20/40 vision will barely be able to read material that just passes the two times test, if he sits in the back of the room. But the person with poor vision will generally make a point of sitting well forward in the room when slides that he wishes to read are projected.

This Room I.F. test described above can be used on any lettering, typing, copy or photographs with fine detail; before or after photographic reproduction.

At a large scientific meeting recently scheduled at the Hotel Stevens in Chicago, fourteen rooms were to be used simultaneously, for either still or motion picture projection, or both. An effort was made to arrange the most practicable conditions for the particular rooms to be used and the actual screen available. In general the room image ratio was far less favorable than the optimum four or five ratio specified by Gage. According to those present, the screen size and visibility equalled or surpassed that for any previous meeting. In order to get large enough screens many rooms were equipped with large bed sheets as screens. During one session when a large screen was not available, it was found that two bed sheets overlapping were quite usable. With a well darkened room and a well adjusted standard 500 watt lantern slide projector there is enough power to cover satisfactorily the double sheet screen. With good tabular or line slides, the common 500 watt slide projector, and about an 8 foot picture, enough light may be used to take notes.

It would be well if lanterns were periodically cleaned and properly adjusted by competent people. A little dirt on the condensers and lenses or a light-bulb slightly out of position may reduce the projection efficiency to 25% or less of normal. In actual practice due to neglect, a surprisingly large proportion of slide projectors are in precisely such a state of low efficiency. Slides should be well prepared too, so that they are of good contrast and not fogged over in the highlights.

Table I shows the general conditions at the Hotel Stevens, and the lenses, lamps and projector-distances chosen under the circumstances. It will be seen that the Room Image Factor varied from 5.6 to 15.2. Throwing out the unusual factor of 15 and averaging all the rest, gives a Room Image Factor of about 8.3. The fact that the average factor is large and the actual factor may be even larger should be kept in mind

when lantern slide material is being prepared for meetings where the projection conditions are unknown.

It might be well to add a few words here about how to choose lantern slide projection equipment to match motion picture equipment. When Mr. Guercio, a motion picture theater equipment supplier, was consulted about the standard lenses supplied on 35mm. motion picture projectors, he stated that a 4½ to 5½ inch lens is standard, a six inch lens is considered long, and an eight inch lens is a rarity. The size of any projected image is governed by the ratio between the focal length of the lens and the size of the object being photographed. According to Henney and Dudley's Handbook of Photography, the present standard 35mm. sound motion picture projector has a gate with an aperture .825 inches wide by .600 inches high. With a 4½ inch lens therefore, the Focal Length/Aperture ratio equals 4.5/.825 or approximately 5.5. This ratio (Projector Image Factor) contains a valuable piece of information. It tells you specifically how far in feet the projector must be from the screen for every foot width of screen image. In other words, to project an image 15 feet wide, a 35mm. sound motion picture projector with a 4½ inch focal length lens must be 15 x 5.5 feet from the screen or 82½ feet. Table II shows the Projection Image Factor for 35mm. projectors with lenses ranging from 4½ to 8 inches in focal length. Table III shows the same factors for 16mm. projectors with lenses commonly used on these projectors. In comparing these factors remember that the 16mm. projector is often used in the middle of an audience.

Mr. Guercio stated that in selecting the proper focal length lens for a lantern slide projector to go with a 35mm. motion picture projector, he multiplied the focal length of the movie projection lens by four. As the maximum aperture of a lantern slide is three inches which is 3.6 times greater than the aperture of the 35mm. film gate, it will be clear from the foregoing discussion that to get exactly the same size image with the lantern slide projector its lens focal length should be 3.6 times as long. A lens four times as long will give a slightly smaller image at a given distance but will be a 90% approximation.

Table IV gives the Projector Image Factors for standard lenses on projectors for 3¼ x 4 inch slides using the maximum permissible aperture of 2¾ inches high by 3 inches wide. Projectors for 2 x 2 inch slides have an aperture of about 1½ inches or half that of standard slide projectors. To find the 2 x 2 Projection Image factors from Table IV therefore, divide the given focal lengths by two.

Motion picture producers have learned to keep their titles down to a few words, to ensure clarity and legibility. This is a habit that lec-

turers might well copy in preparing material for lantern slides. The technical reason for recommending a small amount of copy may be derived mathematically. Each letter will be just legible to a person with 20/20 vision if it occupies a space equivalent to five minutes of arc of his circle of vision. This relationship between size of the letter unit and the whole circle of vision is the Visual Acuity Factor. Knowing this, we can determine the number of just readable letters and spaces as unit-spaces per width of image; but, in order to allow a wider margin of legibility it is better to determine this number for a person with only 20/40 vision. Let us suppose our reader to be at the back of a room 90 feet in length with a screen 10 feet wide hung at the front.

60′ equals 1°. 360° equals the whole circle of vision.

2Π, or 6.28 equals the number of radians in a circle. (A radian is an arc of a circle equal to the radius, or the angle at the center measured by it.) The radius corresponds to the distance from the screen to the back of the room.

(60/5) x 360° equals the number of letters and spaces legible in a full circle, with 20/20 vision.

$$\frac{60/5 \times 360}{6.28}$$

equals the number of spaces per radian for 20/20 vision, equals 688. Thus we can think of 688 as the number of letters and spaces that can be placed on a line at right angles to the line of sight — occupying a total width equal to the distance from the observer to the line.

90/10 equals 9, the Room I.F. 2 equals the 20/20 to 20/40 factor. 2 x 9 equals 18, the Room I.F. testing factor for 20/40 vision.

688/18 equals 38 letters and spaces for a 10 ft. image, seen at 90 feet by a person with 20/40 vision.[4]

In a room with a Room Image Factor of half the factor cited above, twice as many letters and spaces or 76, would be permissible. If small letters are to be used as well as capitals only 80% of 76 should be used or about 60. For general lantern slide work this factor of 60 to 70 letters and spaces probably is a good limit to set. Copy material with a greater number of letters and spaces should be accepted for slide making only after carefully pointing out the possible lack of readibility. Certainly

[4] After you satisfy yourself about the accuracy of the mathematics involved, return again to general figures. Remember that the figure of 5′ of arc for letter size was originally found by trial, and eye test charts shift size by a factor of 3 to 2. Do not look for overall variations of 1 or 2%. Look for 20% to 50 to 100% overall variation in size.

tabular slides with 100 letters and spaces of width should be rejected. As against the theoretical calculations given above, practical working tests have given the same answer. The best general compromise of maximum material when considering legibility, screen sizes, lecturers needs, etc., works out at about 65 letters and spaces. For title work in motion pictures, this should be held down even more. Time available for reading and size of screens often result in less favorable reading conditions than for lantern slides. For titles, then, we can, with good results, consider the width of a motion picture frame to be a maximum of about 40 spaces.

Typewriters with Pica (or normal-sized type) write 10 letters to the inch horizontally and 6 lines vertically. Machines with Elite (or small sized type) write 12 letters to the inch horizontally and again 6 lines to the inch vertically. Special typewriters, Variotypers, printing, etc., have other variations, each of which must be taken up individually.

As to the form and composition of lantern-slide copy, the reader is strongly advised to read the splendid article by Richard M. Hewitt in the Bulletin of the American Medical Association which was reprinted in the JBPA for June, 1937 (Vol. 5, No. 4). Hewitt's approach to the technique of phraseology and manner of writing or tabulating data can hardly be improved. He described the best ways of planning copy, and also some interesting experiments on the legibility of projected slides as carried out in Plummer Hall at the Mayo Clinic.

When slides are used under unknown projection conditions it is well to remember that a Room I.F. of 4.5 is the optimum one can hope for, and that conditions are rarely this good. Set your maximum at about 65 letters and spaces per line. *Whenever possible,* it is well to *keep down to* 35 *or* 40 *letters and spaces* per line. Due to the wide variation in projection conditions and lecture subjects all facts and figures given must be used with a big dose of common sense. Slides are for use as illustrations, not as test charts. The slide should be so prepared that the audience never thinks of it as a slide for which allowances must be made. A good slide should call attention, not to itself, but to the quality of the lecturer's talk. Even where projection conditions are favorable, the brief, well composed slide is the one that is least tiring, holds attention best, and leaves the best impression on the audience.

In preparing copy on a typewriter, good strong black typing is very desirable. A heavily inked ribbon is apt to smudge the writing and so lose clarity. An old ribbon gives a weak letter that is apt to fade out on copying. When the ribbon is not too fresh and strong, the typing may

be made strong and black by restriking each line as typed. If necessary, each line may be restruck two or three times, thus reinforcing, otherwise weak typing. The registration of almost any good typewriter will be satisfactory for this restriking of lines. Needless to say, the type faces should be cleaned before typing the copy.

SUMMARY

Room Length/Image Width is the Room Image Factor, for testing legibility. All Copy should be easily visible at a distance equal to the greater dimension of the copy, multiplied by the Room Image Factor; and at least barely decipherable at twice that distance.

The ratio of Lens Focal Length/Aperture of Gate is the Projector Image Factor. The Projector Image Factor times the screen width is the distance required between screen and projector.

About 650 letters and spaces per radian is the Visual Acuity Factor for 20/20 Vision. This 650 should be divided by the Room I.F. to get the greatest number of just decipherable letters and spaces for 20/20 vision. As a safety measure this number should again be divided by 2, for 20/40 vision.

As a general rule, copy may have a maximum width of 65 letters and spaces per line. The maximum height should be about 90% of the space that the width of 65 letters and spaces occupies.

Whenever possible tabular and data slides should be *held down to* 35 *or* 40 *spaces of width* and a height to correspond.

Motion picture titles should be held to a maximum of 40 letters and spaces for the full projectable frame width.

Copy should be clear, strong, black and bold. For typewritten work, it will often be necessary to restrike each line to strengthen the result from a not too fresh ribbon. Type face should be clean.

Lanterns should be kept clean, condensers, lenses and all; and the lamp should be well centered. Under good conditions, without too large a screen it is often practical to leave enough light on in the room for note taking.

The audience will not struggle to read material which is at the limit of legibility. Make your copy better than just legible.

TABLE I

	Room Size	Image Size	Room I. F.*	Lens	Projector Distance	Lamp Wattage
1.	48′ x 72′	6½′ x 7′	10	15″	35′	500
2.	33′ x 46′	6½′ x 7′	6.6	12″	28′	500
3.	31′ x 65′	6½′ x 7′	9.3	15″	35′	500
4.	23′ x 46′	5½′ x 6′	7.7	10″	20′	500
5.	16′ x 40′	4½′ x 5′	8.0	8″	13′	500
6.	28′ x 40′	6½′ x 7′	5.7	6″	14′	500
7.	28′ x 28′	3¾′ x 5′	5.6 (Movie)	2″	26′	750
8.	84′ x 169′	18′ x 19.6′	8.6	8½″	56′	750
		11.5′ x15′	11.3 (Movie)	4″	160′	1200
9.	33′ x 67′	6½′ x 7′	9.5	12″	28′	500
10.	68′ x 137′	8¼′ x 9′	15.2	15″	45′	500
11.	33′ x 54′	6½′ x 7′	7.7	15″	35′	500
12.	46′ x 68′	6½′ x 7′	9.7	15″	35′	500
13.	40′ x 60′	6½′ x 7′	8.6	15″	35′	500
14.	40′ x 60′	6½′ x 7′	8.6	15″	35′	500

* Room length/Image Width is the Room Image Factor, or Room I.F.
The movie projectors are both 16 mm. type.

TABLE II

35 mm. Sound Projectors
Aperture .825″ x .600″

Focal Length	Projector I.F.
4.5″	5.5
5.0″	6.0
5.5″	6.7
6.0″	7.3
6.5″	7.9
8.0″	9.7

TABLE III

16 mm. Silent Projector
Aperture of E.K. Projector
.380″ x .284″

Focal Length	Projector I.F.
1″	2.6
1½″	4.0
2″	5.3
3″	7.9
4″	10.5

TABLE IV

3¼″ x 4″ Slide Projectors.
Aperture 2¾″ high x 3″ wide.

Focal Length	Projector I.F.
6″	2
8″	2.7
8½″	2.8
10″	3.3
12″	4.0
15″	5.0
18″	6.0
20″	6.7
24″	8.0

Practical Methods of Lettering*

by Louis Schmidt†

THE ability to draw letters and numerals and to use a ruling pen in the preparation of diagrams and curves is a very useful accomplishment for the photographer, even if in practice he need never do more than to place serial numbers and short legends on his negatives.

In some laboratories, it is the practice to place a number, the date, the name of the client, organ, leision and magnification, etc. When this is done, each print from the negative is a fairly complete record of the subject. If this is the plan, it is well to paste across the end of the plate holder a strip of dark card-board that will serve as a mask, thus leaving a clear band at the end of the negative, on which the lettering may be placed and show clearly. Rule parallel lines about one-eighth inch apart on white card-board, to be placed under the clear band of the negative, to serve as a guide for the size and alignment of the letters as they are being drawn on the film. In order that the legend will read from left to right on the print, the film must be reversed and the letters placed on the back and not on the emulsion. If the negative should be on a glass plate, as is not unusual in photomicrography, the legend must be drawn in reverse as ink does not flow smoothly on the glass. In order to make this easier, it is helpful to carefully draw an alphabet on transparent paper and to have this before you as you reverse the letters. As in most cases, this kind of record is for laboratory convenience only, great technical ability is not required.

When lettering is required on prints or transparencies for publications or exhibits, more skill is needed and if the photographer lacks it, the work should be done by a professional letterer. Many pages of illustrations and exhibits, composed of fine prints, are ruined by bad lettering.

Needless to say the ink must be dead black, or if white ink is used it must be pure white. When several prints are assembled together on a page, figure numbers must be placed on them for identification, usually in the lower right corner. If the place where the figure number is to be

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is very light or very dark, the matter is simple, we use black numbers in the light space and white in the dark. If the location is gray or if it is mottled, as it often is in microscopic pictures, neither black or white will serve alone. A black number surrounded by a white line will be best in this case. Great care should be exercised to keep the characters of equal size. Numerals on pages of illustrations should not be less than 1½ mm. in height when printed.

A very useful accessory in planning and placing legends on unmounted prints and transparencies is an illuminated viewing box, having a ground-glass cover. Tracing paper guides, on which lines have been drawn to indicate the size of the letters, may be placed under the subject and moved about to indicate the position and direction in which the lettering is to be placed. For beginners, a carefully drawn alphabet is very useful to have on view. If there is doubt whether a given word or legend will fit into the available space, it is good practice to draw it on tracing paper to fit the space, and by trial and error, work it out on tracing material and slip it under the place it is to occupy, then carefully trace over the guide.

Spacing is one of the difficult matters about lettering. It is not easy to draw a title and place it under a page or a display transparency properly centered, and for this reason again, it is well first to draw your legend to your complete liking as to distribution and spacing on a transparent medium, and then move it under the place it is to occupy and trace it. For most such work a pen of the Speedball type is most suitable because it makes lines of uniform thickness in every direction. It is important that one stroke of the pen will make a line of the proper thickness.

The size of the letters should be such, that when viewed from a proper distance, the letters will be readable, and will also comport with the size of the subject. If the legend is too long to occupy the given space, it is advisable to make the letters narrower and taller than the others on the page. If letters are to be inked on a glossy print, first rub the place where the letters are to be placed with Art-Gum. This will remove enough of the gloss to permit the ink to flow smoothly.

Actually the lines that are used in making lettering and numerals are simple and few. First the student should draw several horizontal lines to indicate the base line, the top of the small letters and one to indicate the top of the capitals. Within these spaces, he should then draw some perpendicular, horizontal, and some diagonal lines as in the A and V; then the half curve as in the C and when the other half curve to the right is added he will get the O. This same curve combined

with the upright and two short horizontal lines will make the D. A little practice in these simple lines may soon be followed by combining them to make complete words and legends. A-V-N-M-U-W may be made without lifting the pen from the paper. Do not, in the beginning, attempt very small lettering. Make letters one-quarter inch high for early practice.

If the page is to be reduced in reproduction, the size of the lettering must be carefully calculated as to height and thickness so that their size will be correct when reduced.

Several devices are obtainable for those who have no talent in hand lettering. The Wrico is one that consists of a number of transparent rulers, pierced in the manner of stencils, so as to serve as guides for letters or parts of letters, using the special pens provided. The under surface of the stencils are hollowed so that they will not smudge the paper when they are moved over the inked surface to bring the various parts into position. A different ruler or template is needed for each size and style of letter. Pens of different thicknesses are available.

There is a more advanced type which makes it possible to draw each letter completely without lifting the pen from the paper. It works by a stilus following the guide letter, which is depressed in the ruler, while the pen draws the letter above the ruler. With this method it is impossible to smudge the work. With it, letters that are perpendicular or slanting may be made from the same template. It is obtainable in a large variety of alphabet styles and sizes and pens making lines of many thicknesses. There is also an arrangement for using the special pens in a penholder for making free hand lettering. These pens make lines of the same thickness in any direction and are in the nature of fountain pens. This is named Leroy and is made by Keuffel & Esser Co., New York and Hoboken, New Jersey.

It is a temptation to use the letters printed on gummed paper because of their neat appearance and easy application. However, they are not recommended because they are likely to drop off the copy and cause trouble and confusion in the editorial offices. If printed or typed on ungummed paper and mounted with rubber cement, they are more likely to remain in place. To use, first rub the place where the number is to go with Art-Gum and place on it a drop of cement, trim the space around the number as close as it needs to be, and place on its back a drop of cement and allow both to dry. Then place the letter, or number, carefully and apply pressure. Any cement that oozes from the edges of the patch may be easily removed by rubbing with a dry finger or soft rubber.

CHATS WITH THE EDITOR

THAT THERE SHALL BE UNDERSTANDING

THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

Answers These Questions About Its Work And The Disease It Is Pledged To Fight:

What is the NATIONAL FOUNDATION FOR INFANTILE PARALYSIS?

The National Foundation is a non-profit membership organization which was established January 3, 1938 to forward action on all fronts of the attack on Infantile Paralysis, including the cause, prevention and treatment of this disease.

Is the FOUNDATION *affiliated with any other organization?*

The National Foundation has no connection with any organization other than its own local Chapters and the Committee for the Celebration of the President's Birthday. This Committee is the National Foundation's fund-raising unit.

How many local Chapters have been organized?

To date more than 2,000 Chapters are serving over 2,500 counties in the United States.

Why were local communities enlisted in this work?

Immediately following the organization of the National Foundation there was a great demand for some means of providing direct local relief to Infantile Paralysis victims. As a result, money now is available for the first time in thousands of communities to meet problems arising from this disease.

What is the program of the local Chapters?

Each Chapter assists those afflicted with Infantile Paralysis, regardless of age, race, color or creed, in the area it serves. This assistance includes providing orthopedic equipment and training, and financial assistance for payment of hospital expenses for patients in need of that care. During epidemics the volunteer workers not only aid those stricken by the disease but also work with doctors and public health officials.

How are the Chapters organized?

A member of the community is selected by the National Foundation to organize and to encourage the participation of others interested in this work. Every effort is made to avoid duplication of the work of existing local and national agencies.

Are the Chapters active throughout the year?

Yes. The chairmen and other volunteer workers serve on a year 'round basis. Their constant enthusiasm and skill in meeting community problems is responsible for the rapid advance of the National Foundation's field program.

What are the FOUNDATION'S *national activities?*

It acts in the national field chiefly as a coordinating, educating and grant-making agency and provides, for the first time in our history, a means of directing, concentrating and increasing the efforts of all who are working to solve the mysteries of Infantile Paralysis.

How are these local and national activities financed?

Funds are received through nation-wide Celebrations of the President's Birthday on January 30th and through the March of Dimes campaign, reported by bankers to be the greatest mass movement of coins in history. Local committees arrange various types of entertainment in observance of the President's Birthday and the proceeds become ammunition in the war against Infantile Paralysis.

Is that the only way in which contributions may be made?

No. Gifts are needed and welcome at all times.

How is the money used?

One-half of the money raised is left with the county in which it was contributed. There it is used by the local Chapter to finance its services. The remainder of the funds is used by the National Foundation to carry on its work in Research, Education and Epidemics. From the organization of the Foundation in 1938 to September 30, 1941. $1,914,160.19 has been used for research, education and emergency aid during epidemics. During the same period, $2,652,009.79 was left with local Chapters for aid to their own communities.

How much of the money is used for fund-raising expenses?

This year, the expenses of the fund-raising unit were only 7.5 per cent of the total amount raised.

How much money will be required for the FOUNDATION'S *work?*

No one can say with any degree of accuracy how much money the National Foundation should have to forward its program. All who are concerned with efforts to defeat Infantile Paralysis realize that substantial sums will be needed to meet present problems and that there

must be a reserve sufficient to meet new developments and emergencies.

How does the FOUNDATION *keep up-to-date with progress made as a result of its grants to research groups?*

The National Foundation's Medical Advisors meet several times each year for the discussion of study results.

Is there any relation between the NATIONAL FOUNDATION FOR INFANTILE PARALYSIS *and the* GEORGIA WARM SPRINGS FOUNDATION?

The two organizations are not related in any respect other than that the National Foundation has granted funds to the Georgia Warm Springs Foundation for the continuation of its research activities. The National Foundation was established as a result of public interest in the work done at Georgia Warm Springs. Following the organization of the National Foundation, President Roosevelt transferred to it exclusively the opportunity of using his birthday as an occasion for raising funds for the fight against Infantile Paralysis.

What is known today about Infantile Paralysis?

This disease has been clinically recognized for about 100 years, but although some progress has been made in the treatment of existing cases, its prevention and cure are among the doors of medical science which are as yet unopened.

What is the cause of Infantile Paralysis?

Infantile Paralysis, more accurately known as Poliomyelitis, is caused by a form of germ too small to be seen even under the most powerful microscope. It will pass through the finest filters and for that reason is known as a filterable virus.

How can symptoms of Infantile Paralysis be recognized?

The symptoms of this disease are in many ways much like those of other illnesses. The safest course, particularly in times of epidemic, is to call a doctor when the patient complains of sore throat, head cold, headache, vomiting, diarrhea, fever, nausea, loss of appetite, nervousness and pain or stiffness in the neck and back. While these symptoms do not always indicate Infantile Paralysis, it is wise to have expert advice and treatment immediately.

What part of the body does the disease affect?

Infantile Paralysis may affect any part of the body. It seldom affects all the muscles, or even all those of any one leg or arm. Groups of muscles and, in some cases, single muscles, may be involved. The paralysis continues to spread for a short time and usually 48 to 72 hours sees its maximum development.

Is Infantile Paralysis, then, a disease primarily of the muscles?

No. Infantile Paralysis is not a disease of the muscles but rather of the

spinal cord and the central nervous system. The damage to these parts of the body then reacts upon the muscles, depending on which body cells are affected.

How is the disease spread from one person to another?

Poliomyelitis, or Infantile Paralysis, is more prevalent during the summer and fall months than at any other time. However, mild outbreaks do occur during the winter. Although there are many theories as to the method in which the disease is spread, there may be as many methods as there are theories. Only continued research can provide the answer to this question.

Is everyone susceptible to the disease?

No. Many persons seem to have developed a resistance or immunity. This immunity is thought to be the result of a previous attack of nonparalyzing and undiagnosed Poliomyelitis or of repeated exposures to doses of the virus too small to do any damage. Nobody, however, can consider himself safe from the ravages of this disease. It strikes regardless of age and often seems to select those who are apparently healthy and active.

Can anything be done to build up an immunity in a child or adult?

At present, medical science reports that the answer is, unfortunately, no. Someday, research such as that made possible by the National Foundation may find a serum, vaccine or drug that will prevent Infantile Paralysis. There is nothing the physician can do today to immunize or build up resistance to this disease.

What can be done?

Although there are as yet no known ways to prevent or cure Infantile Paralysis, there is much that can be done and which should be done by medical science. If notified in time, the physician may be able to prevent serious complications and reduce the crippling after-effects that are a common result of the illness.

What is being done to make care available to those who need it?

In addition to the work of the National Foundation, the federal, state and many local governmental agencies have set aside sums of money to provide care for those who are unable to pay. Under the Social Security Act, federal money is made available to states to aid them in providing medical and hospital service for crippled children in need of such care. Other agencies, operating on a local or national basis, have been established to serve in times of emergency.

The National Foundation for Infantile Paralysis is the largest voluntary organization acting through and in behalf of the American public in the Fight Against Infantile Paralysis.

1941 Survey of Biological Photography

by Milton R. DeLucchi*

A SURVEY, according to Webster's shortest definition of that word, is a comprehensive view. We might then say that an extensive or wide examination of anything is a survey.

Over a period of three months I made a personal visit to a large number of those institutions throughout the United States where photography as it applies to science is being perpetuated. During this time, I traveled more than ten thousand miles, going from the Pacific to the Atlantic and touching both borders, north and south. A numerical listing of those establishments visited would read as follows:

Universities (Medical Schools and University Hospitals	18
Other Hospitals and Clinics	15
U. S. Departments carrying on Biological Photography	4
Medical and Biological Photographic Laboratories (not associated with any institution)	5
Biological Photographic Departments	3
Technical Photographic Departments	6
Photographic and Optical Companies	4

Throughout the course of this trip it was my pleasure to meet more than 70 people either actively engaged in, or closely associated with, biological photography. The majority were occupied with photography as it applies to medicine. It was only because of the extreme kindness and cooperation of this group that the survey was possible.

It might well be pointed out at this time that all statements in this paper are a result of actual observation, and not merely biased opinions of the author.

In order that any survey be of value, it must be conducted along definite lines. That is, there should be specific points checked at all places reviewed. I gave particular attention to three things: cleanliness, equipment, and new methods in use.

Taking into account the fact that the laboratories were seen at a

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time when everywhere there was an unusually large amount of work, due to the then fast approaching convention of the American Medical Association, it is a pleasure to report that the majority of those laboratories visited were very orderly and clean. In some of the departments, provision is made for a daily cleaning of the developing room, as well as frequent general cleaning. The newer laboratories are being constructed in such a manner and of such materials that they will not readily gather dust, and may be very easily cleaned. This is accomplished by such means as greater use of stainless steel which is easily cleaned, elimination of all unnecessary joints where dust might gather and be difficult to remove, etc. At the photographic department of the National Geographic Society, Washington, D. C., the walls of the darkroom are constructed of tile, and are easily washed. A small separate chemical mixing room is another precaution taken by some departments to exclude chemical dust in the developing and printing rooms.

Even with every measure taken to ward off dust, it is still the task of each photographer to see to it that his laboratory is kept free of such dirt as might be caused by accidental spilling of materials used, etc. For the busy photographer, there is nothing quite so bothersome or tedious as having to spot a great deal of work. It is granted that it is impossible to carry on good 35 mm. work under anything but the most orderly conditions. It is apparent that most photographers realize very well that a clean laboratory is not only more pleasurable in which to work, but the actual photographic results show the value of working under clean and orderly conditions.

Unfortunately, it cannot be said that all those visited were appreciative of the value of cleanliness in the laboratory. In a small number of those seen, such things as blank sheets of paper from within packages of cut film, silver wrappings from film, used flash bulbs, and other refuse were carelessly strewn about. Dirty, stained trays, dried crystals all about the developing and fixing tanks, and crystals from spilled liquids on the floor, are a few of the things still to be seen in a small number of darkrooms. It is to be hoped that these conditions will soon be rectified, and that 100 per cent of those in charge of laboratories will realize the value and benefit of working in clean and orderly surroundings.

There are many things that might be said of the equipment used by those departments visited. Taken as a whole, the departments are very well equipped for the various types of work that biological photographers are called upon to perform. It is to be realized that there are

as many different arrangements of equipment to take care of a particular problem, as there are departments. A most interesting observation is that all of these arrangements produce very much the same results. The greatest difference would seem to be the ease with which a particular job might be accomplished.

There appears to be a definite trend toward the use of flash bulbs for clinical photographs. In some cases the use of flash merely supplements regular standard lighting, while in a number of instances flash has replaced regular lighting methods completely. It was noted that those using flash do not use the synchronized type, but rather open flash (stop down the diaphragm—open shutter—flash bulb—close shutter). This method allows the full spectrum of the flash to be used, and not merely the peak. The consensus of opinion is that by this method better color rendition is afforded than by the use of synchronized flash. The amount of time that the flash acts varies according to the bulb used, but in almost all cases it is more than fast enough to stop any action that might occur while taking a clinical photograph.

The Kodatron Speedlamp is favored by some in place of flash bulbs of the ordinary type. For those doing a great deal of flash work, it is felt that the Kodatron type lamp is cheaper to operate, while having all the desirable qualities of the regular flash equipment.

More and more use is being made of fluorescent lamps. This type of lamp is highly praised by all departments using it, as being excellent for copy work, because it gives a beautifully flat light and it does not heat up as do regular lamps.

Stainless steel is coming into greater use. It is more costly than other materials, but there is reason to believe that its lasting quality and the ease of keeping it clean outweighs the slightly higher original cost. It was noted that many of the photographic departments were using this material. (Because of the present emergency, stainless steel will in all likelihood be unavailable for some time to come).

Air-conditioning is also being installed in a number of laboratories. When this can be afforded in the budget, it seems a very excellent investment.

One thing observed in a few of those places visited requires thought. There appears to be a danger of obtaining excellent equipment, and attempting to do complicated photographic processes, color printing, etc., in laboratories that are noticeably cramped for space and of very poor construction.

In telling of new methods in use, I shall of necessity touch upon

many varied subjects. It is impossible to tell about all of the interesting methods observed, so I have sifted these methods down to what I believe will be of value and use to readers of the B.P.A. Journal.

All the methods to be mentioned have been seen by the author while on his survey, and he has absolutely no desire to take credit for the ideas. Some of the methods might well be presented in a separate paper by the person responsible for the method.

There are times when the clinical photographer is called upon to take full length photographs of a patient who is confined to bed. This then necessitates that a large tripod or other bulky equipment be used in order to place the camera at such a height as to look down upon the patient. The possibility of obtaining a directly vertical photograph is very poor. At the Billings Hospital, Chicago, Illinois, provision has been made to take care of this problem. This is accomplished by the use of two full length mirrors. In the center of the room, designed for clinical photography, there is hinged to the ceiling mirror number one. The patient's bed is placed directly under this mirror. Parallel to the patient's bed is placed a tripod holding mirror number two. These mirrors are hinged at such an angle that mirror number one shows a directly vertical full length view of the patient, while mirror number two reflects the image of mirror number one. Standing on the side of the bed opposite from mirror number two, and using his regular tripod, the photographer then photographs across the patient taking a picture of the image in mirror number two.

At the photographic department of the National Geographic Society, Washington, D. C., use is made of the fluorescent lamp in the darkroom. A single tube is hung directly over the sink. This can be turned on whenever it is desired to examine a print which has just been made. It is felt that the quality of this lamp is such that it makes a good examining light. There is some indication that this is not the most suitable lamp because of the interval necessary between the time the switch is turned on, and the time the lamp reaches its full brilliance.

The problem of the correct exposure for photomicrographs when using Kodachrome film is well taken care of in most laboratories. This is accomplished by the use of a photoelectric cell and a galvanometer. By this method, it is possible in almost all cases, to take a direct reading off the ground glass. By the use of an individually plotted chart (to fit the conditions of a particular photomicrographic set up) it is possible to determine very accurately the exposure, not only for Kodachrome, but for all films. It is recognized that the chief dissatisfaction of Koda-

chrome, particularly to clinical photographers for whom it is often impossible to again photograph a particular subject, is the time necessary before it is possible to know whether the exposure was correct. It is claimed by many using the above method for determining the exposure for Kodachrome photomicrographs, that it is possible to send to Eastman Kodak Company quantities of Kodachrome photomicrographs with every confidence that when they are returned they will be correctly exposed.

Mr. Milla, head of the Photographic Division of the Metropolitan Museum of Art, New York City, N. Y., demonstrated a method in use at the museum for photographing helmets of the various suits of armor contained in the museum's collection. First, a clear glass pedestal, such as is often used in millinery shop window displays, is set upon a piece of white paper. White paper is also used as a background. The helmet is placed upon the glass pedestal and photographed by diffused light. When a print is made, the glass support is not visible as the white paper shows through it. Since a diffused light is used when taking the photograph, there are no harsh highlights upon the glass pedestal that might appear in the print. This method might possibly be of use in photographing certain objects in clinical photographic practice.

Another valuable hint from Mr. Milla is the use of paper for backgrounds. It is cheap, and can therefore be discarded as soon as it becomes slightly soiled.

Miss Anne Shiras, Magee Hospital, Pittsburgh, Pa., has made excellent use of slides. Miss Shiras has built up a slide library of medical subjects. Staff physicians may check out slides on a particular subject and use them for class teaching. This library is made up of slides which will be in demand over and over again, not slides of unusual cases that may never be used more than a few times.

Dr. Wayne M. Hull, Balyeat Clinic, Oklahoma City, Okla., has made excellent use of Kodachrome transparencies. Dr. Hull has put his Kodachrome to use, not in teaching students, but rather they are used to teach his patients. This novel idea of visual education for patients is very fine indeed. No doubt, it could very well be adopted by other physicians.

One cannot but notice the great interest shown in color by all those laboratories visited. The general consensus of the many members of the medical profession spoken to, might be summed up in the following words. Doctors want color; give them good color and the demand for photographs will be ever increasing.

Almost without exception, 16 mm. Kodachrome motion pictures have replaced all other forms of cinematography.

Further indication of the interest in color is shown by the fact that a number of laboratories are working on color printing. This is being carried out on an experimental basis, and, as yet, is not being offered as a service to the staff.

There is a very noticeable increase in the use of the smaller 2 x 2 Kodachrome slides. Some of the departments hesitate to use the smaller size, as the change from the standard 3¼ x 4 slide would necessitate new projection equipment and other changes as well. A numerical check up will show that the demand has been so great that the smaller size slide is definitely and rapidly becoming part of the routinely produced material in a majority of biological photographic laboratories.

The field of photography as used to illustrate surgical procedure has also been invaded by the 2 x 2 Kodachrome slide. More and more this small size slide is being used to augment 16 mm. Kodachrome motion pictures, and in one department has replaced the motion picture to a large degree. It is felt that a series of pictures taken during the process of an operation are excellent for teaching. The cost of such a series is less than a motion picture covering the same procedure.

It is to be noted that three out of the four new photographic laboratories (less than one year old) are using 2 x 2 slides. Two of them use the 2 x 2 as their standard. Those using the smaller size slides are by no means attempting to discredit the larger size Kodachrome, but rather, they are supplying a demand which is increasingly becoming greater.

In conclusion, I would like to answer a question that I have so often been asked. "What is the most important thing that you saw while on the survey?"

After much thought, I have come to this conclusion. I did not actually see the most important thing, but I definitely did see the results of this thing. No, it was not a new photographic apparatus, nor was it a new process, rather, it was something as old as time itself. "Cooperation!" Close cooperation and understanding between photographer and client, between photographer and administration. That, in my opinion, is the most important lesson for the biological photographer to understand.

A careful check-up will prove beyond a shadow of a doubt that at those institutions where there is close cooperation and understanding between photographer and client, and also between photographic de-

partment and staff administrators, there are not only better equipped laboratories, and also superior photographic results because of this co-operation, but there is likewise a broader and more progressive view of photographic possibilities taken by all concerned. I do not think that this point can be over-emphasized. It is heartening to see that this is realized by many of those engaged in biological photography, and, I believe, that this spirit of cooperation is particularly shown by the excellent new departments just formed within the last year.

THE REPRODUCTION OF UNUSUAL COPY FOR PUBLICATION

by LOUIS SCHMIDT

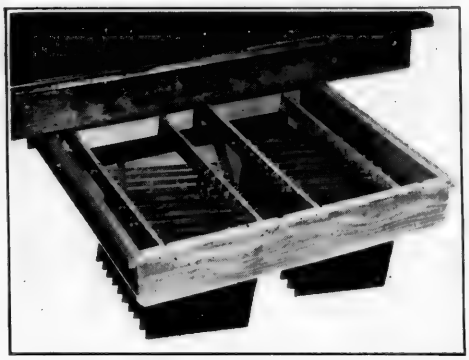
By far, the greatest number of scientific illustrations are reproduced for printing by the half-tone process. Seldom is a screen finer than 175 lines to the inch used. This is fine enough to show the details of most subjects. Among the exceptions are rickettsiae and elementary bodies. These are so small that they are no larger than a dot on the screen.

Recently there came to hand a fine water-color drawing to illustrate a paper on, "The Infection of Irradiated Mice with European Typhus," Journal of Experimental Medicine, Vol. 72—pl. 23. Machiavello stain, magnification 1300, two circular fields which showed cellular exudate, stained jade green and orange. In *IA,* the third passage in a mouse infected with blood. In *IB,* the eleventh passage in a mouse infected with blood.

The explanation of plates stated;—Note the comparative richness of the intracellular and extracellular rickettsiae in the earlier and later mouse passages. Both figures were powdered with very fine pale green spots, and darker ones of green on an extremely pale green ground. There were no funds for a colored lithographic reproduction, so a monochrome photograph was made and this was rendered in full-tone collotype by Meriden Gravure Company. This would seem the only solution.

A SIMPLE CUT FILM DRYER

A common method of drying tank developed cut film, in which the film is encased in an individual film hanger, frequently is nothing more than a wire strung across the processing room. This exposes the film to much free dust and, if hung low, the danger of spattering by water or liquid chemicals. If the wire is high, individuals passing beneath the hangers are dampened by the descending moisture.



A simple dryer which obviates many of the difficulties inherent in improvised drying systems has been employed by the writer for some time. It is not known who first used this method. It was observed in use by a colleague at a nearby institution who had in turn seen it elsewhere.

The dryer to be described is designed for 5″x7″ film hangers. Any other size would require different dimensions. Essentially it consists of a bottomless drawer which is installed under one of the processing room work tables. It contains four slotted bars ½″ x 1¼″ x 18″. The slots are cut ½″ deep and 1″ apart and of sufficient width to accomodate the film hanger. The drawer will hold 30 films. The right hand bar of each of the two rows is set 1½″ lower than the left side to allow for drainage of water and more rapid drying. The extreme right and left bars should be set 1½″ in from the side of the drawer frame. The two middle bars should be spaced 1¼″ apart. The height of the drawer front may vary considerably. The drawer being described has sides which are 3½″ high and a front which is 22″ wide.

By employing a drying drawer of this type, the film is protected and not occupying other useable space. Drying is reasonably rapid and it could be accelerated by installing a small fan under the table to blow an air stream parallel with the film. The table top must be waterproof, or there is danger of fluid seeping through if any is spilled on the table. If this seepage drops on partly dried film, it will cause drying marks. A shallow metal tray may be placed on the floor to catch drippings from the film if necessary.

F. R. HARDING,
Children's Hospital, Boston, Mass.

MEDICAL ART IN THE UNITED STATES ARMY

The Medical Department of the Army is about to activate the so-called Medical Art Service which has been mentioned from time to time in this Journal. This will include clinical photographers as well as artists in the other fields.

These are already on file in the Museum completed questionnaires of members of the Biological Photographic Association, as well as those of a large group of medical artists and from this file will be chosen the limited number that it will be possible to use in this service. The majority of them will have to be males and used in the enlisted grades. It will be possible to use some of the medical artists, particularly the females, in the larger hospitals in this country on a Civil Service status.

Clinical photographers who are likely to be called into the service, or who are already in the service, should notify the Curator, Army Medical Museum, 7th St. & Independence Ave. S. W., Washington, D. C., giving particularly their military status and address if already in the service, and age, experience, training, etc., if they have not already furnished the Museum with the questionnaire.

Protect Your Future

BUY DEFENSE BONDS *and* STAMPS

News From the Trade

News from Bell and Howell:

New Government Films Train Defense Machinists: The first of a series of more than fifty machinist and industrial training films, prepared under the direction of the United States Office of Education, was no sooner off the drying rack than it was put to use before an audience of machinists, operators, and apprentices in one of Chicago's defense plants. Following the initial showing of "Cutting a Spur Gear," the film will be repeated before smaller groups, within the plant, under instructor guidance for more intensive training.

The Bell & Howell Company, Chicago, in addition to its own intensive use of the films is devoting its film library channels to the loan and sale of copies to industries, schools, and other organizations. Printing and general distribution is handled by Castle Films, under governmental contract.

The films may be purchased at a price that represents bare printing and shipping cost, with the entire expense of actually producing the negatives absorbed by the government as defense cost. A score of the country's leading producers of industrial, commercial, and educational motion pictures have participated in the production of these films.

The pictures can be run on any 16 mm. sound projector, but silent machines cannot be used. Firms, schools, or Educational Institutions having no machines can make arrangements for projection service, and can borrow copies of the films desired, at a moderate handling charge.

The Filmosound Library announces 8 mm. film rental service: The initial listing includes 75 subjects consisting of features, cartoons, sport shorts, travel subjects, musicals and novelties. Both black-and-white and color subjects are available. Rental charges are 75c per reel on monochrome and $1.50 per reel on color subjects.

News from Advertising Displays, Inc.:

Advertising Displays, Inc. of Covington, Ky., announce the Stereotach, which is an attachment placed over the lens of any 35 mm. double frame miniature camera. It produces stereoscopic pictures either in black-and-white or Kodachrome. This attachment appears to simplify the making of stereos, as it is no longer necessary to have a special camera for this purpose. This company also markets the Stereo-Jector lens which, by adapters, replaces the lens on most 2 x 2 projectors. Further information can be had direct from the manufacturers.

Mansfield Fototint Trial Offer:

In order to make it possible for any darkroom fan to test for himself and personally become acquainted with FOTOTINTS for tinting movie scenes, black-and-white titles for splicing into color reels, and 35 mm. slides, *Mansfield* is now offering, for a limited time only, a special introductory trial-size of FotoTint.

Trial-size FotoTints come in gelatin capsules containing sufficient FotoTint to color 100 feet of movie film. All the user needs to do is to empty the contents of a capsule into water, immerse film in tinting solution for a couple of minutes, rinse and dry the film.

Six trial-size capsules, one each of Sapphire Blue, Amber Brown, Emerald Green, Royal Purple, Fire Red and Sunlit Yellow, all for 25c, are obtainable by writing to the Mansfield Photo Research Laboratories, 701 S. La Salle St., Chicago, Ill.

Wabash Appliance Corporation, Brooklyn, N. Y.

Designed for blackout lighting in air raids, the new Wabash Blackout bulb just announced by the Wabash Appliance Corporation, provides downlighting in a soft beam of blue light that is safe for indoor visibility during blackouts. The bulb is lined inside with a pure silver reflector lining that hides all filament glare and projects the light downward. Light leaks are prevented by a black silicate coating that covers the bulb up to the extreme lighting end which is a deep blue. The new bulb consumes 25 watts and will list at 45c.

Outfit for Testing Fixing Baths Announced by Kodak

To enable every photographer to answer for himself the question, "How fresh is the fixing bath?", Eastman has just introduced the Kodak Testing Outfit for Acid Rinse and Fixing Baths for Paper. A compact, two-bottle kit, the unit contains sufficient material to keep the average photographer well informed on this point for many weeks.

According to the company, the fluid in bottle "A," the acid rinse bath test, will turn purple when added to an acid rinse bath whose acidity has fallen to a point beyond which it is unsafe for further use. In a similar manner the fluid in bottle "B" will combine with a fixing bath to produce a heavy yellow precipitate if the bath is exhausted.

Designed particularly for use with rinse and fixing baths for paper, the Kodak Testing Outfit is said not to be usable for testing film and plate fixing baths. The complete kit is priced at $1.00.

Eastman Kodak Company:

The contact printer, that ugly duckling of photo processing, has been streamlined, modernized, and made increasingly efficient in the new

compact Kodak All-Metal Printer Model 2 just announced by the Eastman Kodak Company.

Designed for making contact prints the Model 2 All-Metal Printer has many features which will appeal to the photographer. It accepts negatives ranging in size from 35-mm. up to 4 x 5½-inches. It has four easily adjustable, inch-wide, margin masks. It permits strip printing of many popular sized roll films, and it has provision for the introduction of printing controls such as ground or opal glass.

Hardly larger than a small packing box (actual dimensions are 10 x 8 x 6-inches), but fully as efficient as much bigger professional printers, the Model 2 All-Metal Printer includes as a supplementary feature ruby Kodaloid scales which are illuminated from below by the printer's ruby safelight. These white-etched scales can be easily read under any conditions, and make it a simple matter to obtain exact margin widths at all times.

Users of 35-mm., Nos. 127, 620 and 616 film, will find it particularly useful since the machine is designed to allow strip printing of those films without having to cut them into individual negatives.

As for additional printing control, on the left side of the Model 2 All-Metal Printer is a slot through which diffusing materials — such as ground or opal glass — can be introduced to reduce the intensity of the printing light.

Agfa Ansco Announces 32-oz. Size Finex

Amateurs and professionals who require an ultra-fine-grain film developer in quantities for large-size developing tanks now will be able to purchase Agfa Ansco's *Finex* in quart bottles. This ready-to-use developer produces extremely fine grain with no loss in the inherent film speed.

Through the recommended laboratory replenishing system, the 32 oz of *Finex* permits a total of 60 rolls of 36-exposure miniature-camera film (35mm.), or 60 rolls of B2-size (120) rolls, or equivalent amount, to be developed. This is accomplished without increasing the developing time which remains constant throughout the entire life of the developer. The label on the 32 oz. *Finex* contains a chart which may be used to keep an accurate check on the number of square inches of film that has been processed.

The economical quart-size bottle is sold separately from the *Finex* Kit and is complete with a 25-page instruction booklet plus a handy 2 oz. glass graduate which facilitates accurate replenishing. The 8 oz. size *Finex* Replenisher may also be purchased separately. Developer and Replenisher are available in 5 gal sizes on special order.

Association News

B.P.A. SECTION IN THE PRINT EXHIBIT OF THE PHOTOGRAPHIC SOCIETY OF AMERICA

Shown During October and November 1941 *in the Museum of Science and Industry*

Our committee in charge of the B.P.A. section of this exhibit consisted of three members from the Chicago Chapter, Mr. Ralph Creer, Mr. William Martinsen and Mr. John Maurer. The following list of prints and summary of remarks were taken from a report by Mr. Maurer.

Frank Ruslander

1. Brain. Chromatone.
2. Bowel Specimen. Chromatone.
3. Scratch Test. Medical Illustration.
4. Hypodermic Injection — multiple hypodermics — Medical Illustration.
5. Operation Incision. Medical Illustration.

Jocelyn Crane

6. Turbo fluctuosus x12.
7. Coat of Mail Snail x6.6.
8. Nurseshark Skin x21.

Dr. William Beebe

9. Young Surgeonfish x41.
10. Flying Insect at rest.
11. Black Frogfish x4.

E. P. Haddon

12. Coon in Camp.
13. Doe with triplets.
14. Plains Monarch (Bison).

Cornelius Denslow

15. Peek-a-boo.
16. Dewdrops.
17. Fiddleheads.
18. Grumpy.

F. Griffith

19. Amorphophallus.
20. Amorphophallus (Detail).
21. Victoria Regia Leaf (Section).
22. Victoria Regia Leaf (Underside).
23. Leaf Patterns.

Fleischmann Laboratories
24. Vitamin B1 x100.
Pohlman Studios.
25. Iris Flowers (?).
26. Peaches (Color).
A. Marfaing
27. Pigmented Nevus.
28. Corneal Transplant.
29. Anterior Pathology.
Dr. Arthur W. Proetz
30. Human Nasal Cilia
C. Graham Eddy
31. Brain Carcinoma from Pancreas.
Dr. A. Vass
32. Team.
Dr. Ralph E. Alexander
33. Thyroidectomy.
Lydia Eskridge
34. Brother Rat.
William Payne
35. 10^6 Volt X-Ray.
Skin reaction,
Ca of Stomach.
Albert Sadler
36. Methylene Blue staining of Breast Section.
Lardner A. Coffey
37. Oxygen Mask.
G. M. Busanovich
38. X-Ray of Lungs.

These prints were on display for a little over a month and seemed to be well received by the public. They were displayed in a well lighted section opposite the Nature prints of the PSA. Except for two prints on larger mounts, we showed only prints mounted on 16 x 20 mounts. Many excellent photographs considered by our committee had to be rejected because the mounts were too small for a show of this kind. The committee recommends our insisting on the 16 x 20 mount for our own Salons from now on, as this is practically the standard exhibit mount, and our adoption of it would make it simpler to enter prints in other shows. There are also standard hard fibre cases for shipping mounts of this size, and such cases make transportation easier and safer.

The committee chose prints for this show not only from our 1941 Salon but from selected prints of several Salons back. They report that judging from this cross-section, our print quality is rising sharply. They recommend that in order to make us all more critical of our work we should exhibit in various shows more often and keep constantly raising our standard of acceptance.

New Members

We take pleasure in announcing the following new members:

Barr, Daniel R., M.D., (*Louis Schmidt*[22]), Grand Rapids, Ohio.
Blakely, Miss Keturah D., 419 West 119th St., New York, N. Y.
Callahan, Alston, M.D., Ponce De Leon Eye & Ear Infirmary, Atlanta, Ga.
Carlin, R. W., 1 East 100th St., Chicago, Ill.
Cochran, Ellsworth, (*J. A. Bledsoe*), University of Cincinnati, Cincinnati, Ohio.
Crane, Jocelyn, 33 West 67th St., New York, N. Y.
Dame Lawrence R., M.D., 57 Federal Street, Greenfield, Mass.
Davis, David, M.D., 1835 Eye Street, N. W., Washington, D. C.
Ellis, Arthur E., (*Frank Ruslander*[4]), 39 Hill Street, Battle Creek, Mich.
Good, Louis P., M.D., 401 East Fifth Street, Texarkana, Ark.
Hackel, Joseph P., 167 West 57th Street, New York, N. Y.
Hacker, Henry J., P3/c, Fleet Air Photo, NAS, Pearl Harbor, T. H.
Hadsall, Dr. Leo F., (*Leo Massopust*[10]), Fresno, Route 1, Box 368, California.
Holinger, Dr. Paul H., 700 N. Michigan, Chicago, Ill.
Jardine, Mrs. Evelyn N., (*Leonard Julin*[4]), 2 Maynard St., Hanover, N. H.
Kogut, Benj., M.D., (*Francis J. Johlfs*), 60 Plaza Street, Brooklyn, N. Y.
LaRue, Mervin W., 6434 N. Artesian Avenue, Chicago, Ill.
Lefkoe, Harold, M.D., 5217 N. Broad Street, Philadelphia, Pa.
Lubinsky, George, (*F. A. Mettler*), 227 Audubon Avenue, New York, N. Y.
Lyerly, J. G., M.D., (*Clayton E. Royce*[3]), St. Vincent's Hospital, Jacksonville, Fla.
Miller, Lucille B., (*Oscar Richards*[7]), Edw. J. Meyer Memorial Hospital, Buffalo, N. Y.
Morton, Dr. Thomas H., (*Oscar Richards*[8]), 1345 Maple Avenue, Niagara Falls, N. Y.
Mund, Maxwell H., (*Arthur W. Proetz*[3]), 4935 McPherson Ave., St. Louis, Mo.
Oschman, Margaret B., 419 West 119th St., New York, N. Y.
Pearlman, Samuel J., M.D., 55 East Washington St., Chicago, Ill.
Peiser, Miss Gisela C., Cliftonville, Cambridge, England.
Peterson, Miss Harriet, (*Robert T. Morrison*), 529 8th Street S. E., Minneapolis, Minn.
Reed, Frank C., N. Y. State Dept. of Health, Albany, N. Y.
Schooley, J. P., Ph.D., Difco Laboratories, Inc., Detroit, Mich.
Schultz, Samuel, M.D., (*Anne Shiras*), Philip, S. D.
Tomb, Everett H., M.D., (*R. P. Creer*[17]), 46 Lexington St., Farmingham, Mass.
Tucker, Gabriel, M.D., (*R. P. Creer*[18]), 250 S. 18th St., Philadelphia, Pa.

Waldeck, Robert, (*Alex Gravesen*), 1185 E. 18th St., Brooklyn, N. Y.
Weston, R. McV., Houndwood, Salisbury, Wilts., England.
Wetherell, Frederick S., M.D., (*Stella Zimmer*[2]), Medical Arts Bldg., Syracuse, N. Y.
Woods, Lawrence C., Jr., 200 Frick Bldg., Pittsburgh, Pa.
Zorn, August S., (*C. Graham Eddy*[2]), Eloise Hospital, Eloise, Mich.

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1941-1942

Ayerst, McKenna and Harrison
Rouses Point
New York

Dr. J. C. Burnett
Alpine
New Jersey

Mr. Louis P. Flory
Boyce Thompson Institute for
Plant Research
1086 Broadway
Yonkers, N. Y.

Mr. Leonard Perskie
The Defender Photo Supply Co.
275 Seventh Avenue,
New York, N. Y.

Dr. Arthur W. Proetz
12 Westmoreland Place
St. Louis, Missouri

Dr. George H. Semken
16 West 85th Street
New York, N. Y.

Miss Anne Shiras
University Office
Magee Hospital
Pittsburgh, Pa.

Mr. William J. Taylor
Temple University Hospital
Philadelphia, Pa.

Mr. Lloyd E. Varden
Agfa Ansco Company
Binghamton, N. Y.

BACK NUMBERS NEEDED

The Biological Photographic Association is sorely in need of back issues of journals listed below to fill out complete volumes. By supplying any of these numbers anyone who does not require them for binding will render a real service to the society. We are authorized by the Board to offer up to 50 cents apiece for the specific copies listed below.

Vol. IV—No. 1 (Sep., 1935)
No. 2 (Dec., 1935)
No. 3 (March, 1936)
Vol. V—No. 1 (Sep., 1936)
No. 3 (March, 1937)
No. 4 (June, 1937)
Vol. VI—No. 1 (Sep., 1937)
No. 3 (March, 1938)
Vol. VIII—No. 2 (Dec., 1939)

B. P. A. Officers and Committee Chairmen

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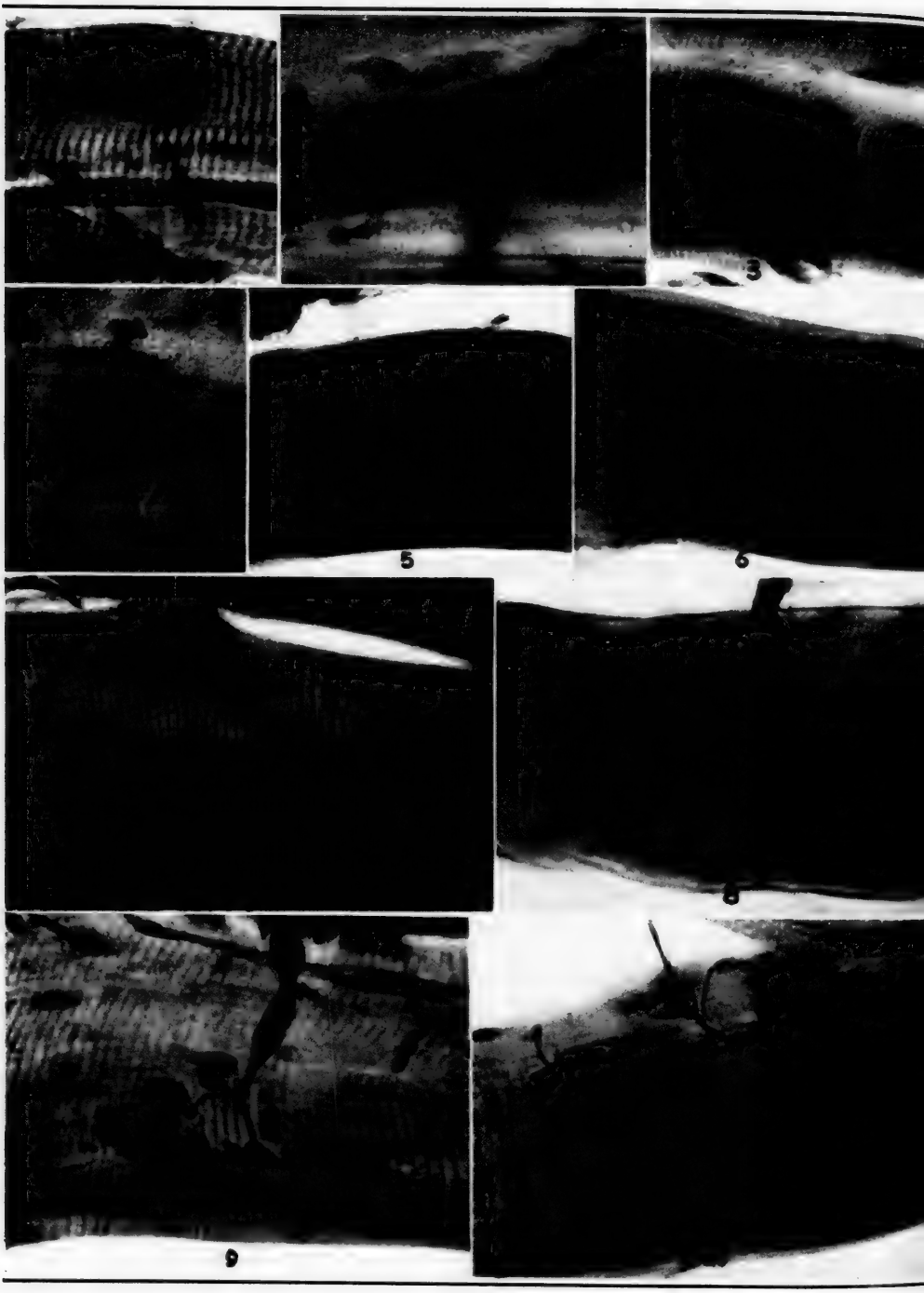
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The Structural Variations of Motor Nerve Plates

by Eben J. Carey, Leo C. Massopust, Eugene Haushalter*

THE significance of the multiple configurations of the motor end plates and the related cross striations in striped muscle fibers is unknown. Hines (1931) states that these nerve plates are "morphologically lawless," and Wilkinson (1929), that the numerous forms of the grape-like endings may be immature states of the motor plates. Neither of these authors nor Kühne (1887) assign a functional significance to the multiple forms of the nerve plates in the fibers of the striped muscle. As to the role of the cross striations in

---

Plate 1

PLEOMORPHISM OF THE MOTOR NERVE PLATES AND OF THE RELATED MUSCLE STRIAE DURING HYPERPNOEA

Teased intercostal muscle of the white rat (No. 38) when respiration was accelerated by inhalation of carbon dioxide. Gold chloride technique, counterstaining with hematoxylin. Magnif. 750 X.

Muscle fibers with coarse, widely spaced cross striations (as in Figs. 1 and 3) are associated with nerve plates consisting of coarse fronds, whereas the muscle fibers which have more obliterated dark bands (Figs. 9 and 10) are associated with nerve plates consisting of thinner branches. There are 15 dark striations related to the nerve plate with coarse fronds (Fig. 1) and 40 dark striations related to the fully expanded nerve plate with fine branches (Fig. 10).

Figures 5, 6, 7 and 8 represent intermediate stages. The muscle striae vary from the rather coarse kind of Fig. 5 to the fine type of Fig. 8, while, at the same time, the nerve plate varies from the compact form (Fig. 5) to the more finely branched type (Fig. 8). There are still traces of the sole plate of Kühne in Fig. 5, but none in Fig. 8. The striations are often obliterated in the proximity of the nerve plate (Figs. 5, 6, and 8).

In some places the periodic structure of the muscle is replaced by a diffuse arrangement of granules. The granular sole plate of Kühne is usually associated with retracted nerve plates (Figs. 2 and 4) and is diminished or absent in the expanded ones (Figs. 9 and 10). The blue stained nuclei of the sole plate are displaced out into the muscle substance when the stimulated nerve end is expanded (Figs. 9 and 10).

These investigations were carried out with the aid of grants for research to the Department of Anatomy of the Marquette University School of Medicine by the Committee on Scientific Research of the American Medical Association and the National Foundation for Infantile Paralysis, Inc.

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muscle contraction, it still constitutes, after one hundred years of study, one of the most confusing chapters in the biology of living organisms.

The object of this paper is to present further evidence from photomicrographs to substantiate the view already expressed in previous papers: (1) That the morphologic changes (pleomorphism) of the motor nerve plate is the structural expression of protoplasmic streaming and functional ameboid motion in the periodic retraction and expansion of the axonic ramifications of the nerve end; and (2) That the pleomorphism of the cross striations is closely related to the multiple forms of the nerve plate.

MATERIAL AND METHODS

Forty white rats were anesthetized by the intraperitoneal injection of nembutal. A one-inch vertical incision, 1 cm. to the right of the midline of the spine, was made through the skin and muscle down to the ribs. The sixth, seventh, and eighth ribs and the related intercostal muscles were excised quickly in one piece. The excised part of the thoracic wall was run through the gold chloride technique and was used as a control of the relatively normal motor end plates. The skin was sutured over the thoracic gap and the animal immediately placed for 3 to 10 minutes in a jar, the air of which contained roughly 15% of carbon dioxide. The rat was then removed from the jar and the third and fourth intercostal muscles of the right thoracic wall were quickly excised and run through the gold chloride technique for microscopic study of the teased muscle fibers and motor end plates. After the skin was again sutured the animal was allowed to breathe normal air for a period of four hours, and then it was decapitated. The ninth, tenth, and eleventh right intercostal muscles then were excised, subjected to the gold chloride technique and teased.

The respiratory rate after nembutal anesthesia varied from 22 to 60 per minute. During excision of the piece from the thoracic wall it increased from 60 to 80 per minute. This was the reason for making the first incision through the ribs along the dorsal side, thereby quickly severing the nerve supply to the excised muscles before the respiratory rate changed. When the rat was placed in the carbon dioxide, the respiratory rate increased at once and varied from 120 to 215 per minute. When the rat was allowed to breathe normal air again, the average rate of respiration fell to 65 per minute within 30 minutes.

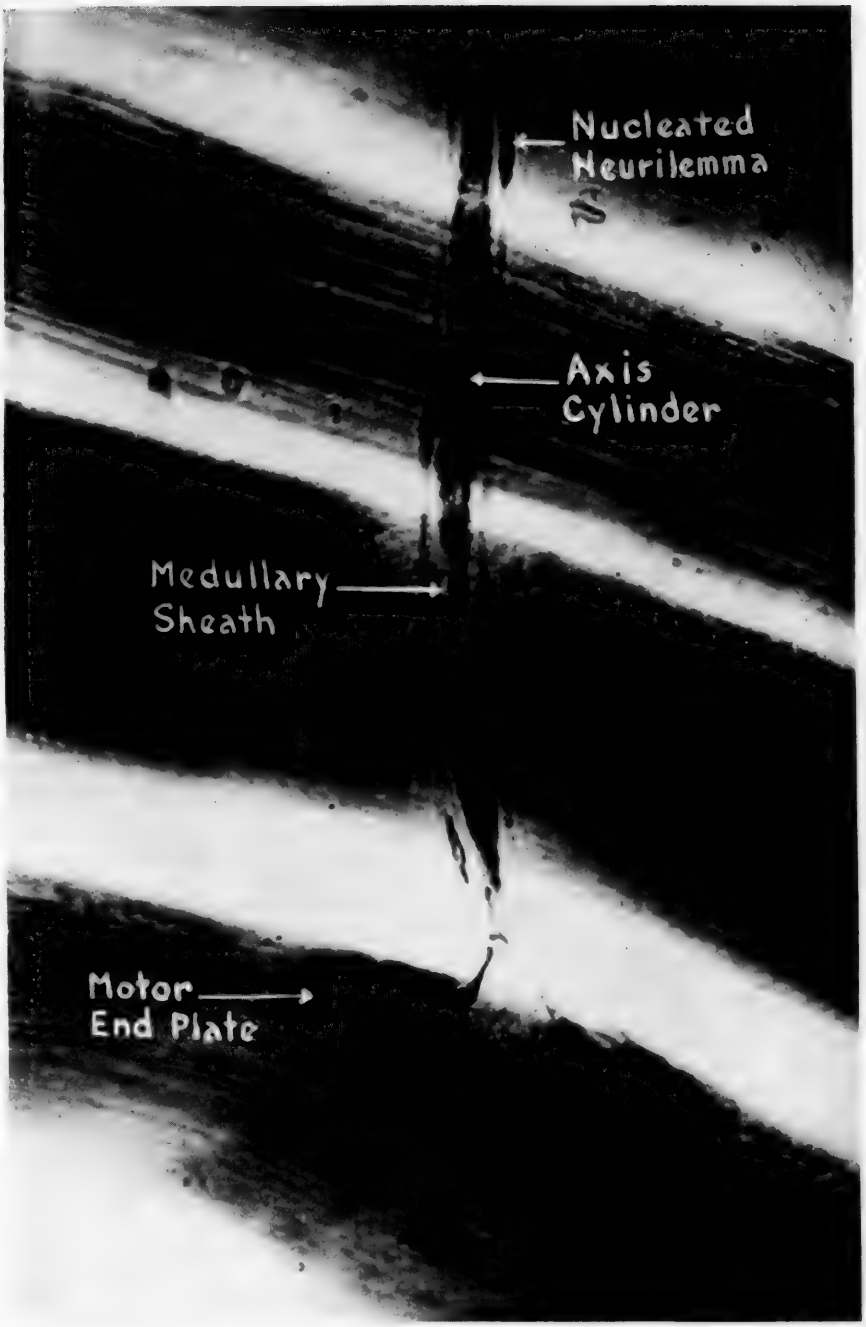

Figure 11. Motor end plate with associated morphology in the gastrocnemius muscle of the chameleon.

By this simple means the histologic changes in the same group of motor nerve plates in the same animal were observed under different degrees of functional activity induced by carbon dioxide stimulation.

The influence of the elevation of temperature upon the motor nerve plates was studied by comparing these endings, in the rectus abdominis muscle of the chameleon exposed, while alive and intact, to temperatures of 20 ° or of 45° C. The chameleon suffered heat rigor after an exposure of 20 seconds at 45° in Locke's solution. The animals were then quickly skinned and the muscles subjected to the gold chloride technique.

MICROTECHNIQUE

The technique employed to stain this tissue was, first, the Ranvier lemon juice gold chloride method as modified by Carey[1], and second, the Galigher[2] Standard alum-haematoxylin method. The technique, briefly, is as follows:

Small pieces of intercostal muscle (3-5 mm) were cleared in fresh lemon juice for about 10 minutes. After the lemon juice was removed from the container a 1% gold chloride solution, about 50 times the tissue volume, was poured over the muscle and placed in the dark for 20 minutes. The gold chloride solution was then poured off. The gold chloride impregnated in the tissue was reduced in a solution of formic acid, one part formic acid to three parts distilled water, for 12 hours. After 12 hours in formic acid the tissue was washed with tap water and placed in a mixture of equal parts of 50% alcohol and glycerine, until teased. In teasing, the muscle tissue is cut with sharp, flat-bladed teasing needles into small strips following the long axis of the muscle fibers, and then oriented in a drop of glycerine on a 1″ x 3″ slide. A number one ⅞ inch cover slip was placed on the small strip of tissue. Gentle pressure on the cover slip spreads out the tissue to about one fiber in thickness.

The mounted tissue to be counterstained with haematoxylin was selected and counterstained as follows:

The cover slips were gently raised with flat-bladed teasing needles, so that the tissue, without being disturbed, adhered to the microscope

[1] Carey, Eben J. STUDIES ON AMEBOID MOTION OF MOTOR NERVE PLATES. 11. Pathologic Effects of CO_2 and Electricity on the Explosive Ameboid Motion in Motor Nerve Plates in Intercostal Muscle. "The American Journal of Pathology." Vol. XVIII, pp. 237-289.

[2] Galigher, Albert E. THE ESSENTIALS OF MICROTECHNIQUE. Pub. Albert E. Galigher, Inc., Berkeley, Calif. pp. 178-182, 1934.

slide. The excess glycerine around the tissue was removed with a clean cloth. A drop of diluted standard alum haemotoxylin (one part haematoxylin to one part of distilled water) was spread over the tissue on the slide. The progress of the staining of the nuclei was observed under the microscope. When the proper degree of nuclear distinction was observed, the haematoxylin was washed off with slightly acid distilled water (about two drops of HCl to 100 cc distilled water) without disturbing the tissue. The tissue was then covered with ammonia water (0.5 cc to 100 cc tap water), which brought out the blue nuclear stain. The glycerine and cover slip were replaced and the slip was sealed in place with Clarite. Clarite is a nitrocellulose product superior to most prepared cements, varnishes or paraffins for sealing cover slips to slides. Mounts prepared in this way have kept perfectly in this laboratory for more than two years.

Photographic Technique

Carbon arc illumination was used without a filter, with Type B Kodachrome.

To ascertain the exposure time, test-strip exposures were made on Portrait Panchromatic film without a filter. After development, a strip was selected which showed a good brightness range from black to the clear film. The exposure time of this strip was then multiplied by three and used as the exposure time for the Kodachrome. Since the magnification for figures 1 to 10 remain the same there was no variation in the exposure time of all ten photomicrographs.

It is obvious that photomicrography in color is the best means of illustrating the delicate differences of structure in these preparations.

Summary

1. Photomicrographs of nerve end plates from the intercostal muscles of the white rat, fixed while the animal was in hyperpnoea or in normal condition, show that, in general, relaxed muscle fibers with coarse, widely spaced cross striations are associated with retracted nerve plates consisting of coarse fronds, whereas contracted muscle fibers with more obliterated dark bands are associated with expanded nerve plates consisting of thinner branches. Furthermore, granular sole plates of Kühne are associated with retracted nerve plates.

2. Photomicrographs of nerve plates from the rectus abdominis of the chameleon, fixed after exposure to 20° or to 45°C, show, in general,

larger amounts of nerve substance in end plates after treatment at 45° than after treatment at 20°.

3. These observations fit in well with the idea that, during the functional activity of the myoneural junction, which can be increased by stimulation with CO_2 or by exposure to high temperatures, there is a passage of material from the nerve plate to the receptive muscle substance.

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Abstracted from "The Anatomical Record," Vol. 81, No. 3, November, 1941, and "Biodynamica," Vol. 3, No. 78, December, 1941.

Editor Note: The complete study of this problem was presented in an exhibit in the Scientific Section at the convention of the American Medical Association at Atlantic City, June 8-12, and received the gold medal award.

OPPORTUNITIES FOR CLINICAL PHOTOGRAPHERS AND MEDICAL ARTISTS IN THE UNITED STATES ARMY

The Medical Corps of the United States Army is now ready to activate the Museum and Medical Arts Service which has been mentioned from time to time in this JOURNAL. The organization of experienced personnel will be one of the first objectives.

In order to obtain a list of qualified clinical photographers, the members of the Biological Photographic Association filled out questionnaires which were submitted to the Surgeon General of the Army.

Now that definite plans are underway, there is a need for trained clinical photographers. Those who can qualify as medical artists, as well as photographers, will be especially desirable. Moulage workers will also be needed.

There are a few clinical photographers who are already in other branches of the armed service. Wherever possible, they may be transferred to the Museum and Medical Arts Service. Certain men and women on the approved civil service list may be chosen for duty at base hospitals in the United States. Clinical photographers of draft age who are likely to be called into the service will be especially interested in this notice, since they will have an opportunity to apply in advance for a type of work in which they are entirely familiar.

Those who wish to serve in the clinical illustration units, or who wish further information, please write — Curator, Army Medical Museum, 7th and Independence Avenue, Washington, D. C. State age, sex, experience, specialty, *draft board classification,* etc.

A Method for Determining Exposures for Photomicrographs

by Harold M. Hefley and Arlo I. Smith*

Introduction

It is ordinarily a simple matter to determine the exposure required to yield a negative of optimum density with a photronic exposure meter. The problem becomes much more complicated when taking photomicrographs, especially with a compound microscope. Here it is not practical to determine the relative f number of the lens system. There is no standard method of determining the intensity of light emanating from, transmitted by, or reflected from an object of microscopic proportions.

A number of alternatives present themselves. Most recent are those of Allen (1941) and the Eastman Kodak Company (1942). The former is essentially a refinement of the test exposure method together with a series of computations based on an optimum exposure determined by trial and error. The latter method demands a calibration of a photronic exposure meter from data obtained by a series of trial exposures with the light intensity measured at the eye-point (Ramsden circle) of the microscope ocular. An arbitrary f number of the microscope which has no direct relation to the optical system employed is also derived.

Few who take photomicrographs only from time to time can afford to determine a series of standard data empirically, and then calculate up to five deviations from the standard for each exposure made. Errors in computation occur, and the trial and error method is rather expensive, especially when kodachrome, or other color film is used. The method which follows is an attempt to simplify some of the usual practices.

* Department of Biology, Texas Technological College, Lubbock, Texas.

Appreciation for suggestions and criticisms is expressed to the following persons: Dr. Dean R. Parker, Dr. Harry Hill, and Dr. C. C. Schmidt. Dr. William M. Craig is thanked for the loan of certain apparatus. Dr. Jules de Launay performed most of the mathematical computations which form the basis of the experimental work.

MATERIALS AND METHODS

The apparatus used consisted of a Spencer Research Microscope with apochromatic objectives and compensating oculars, and an achromatic aplanatic condenser n.a.1.4, a Leica camera with copying attachment and various extension tubes, Leitz 50 mm f 3.5 Elmar lens, Zeiss Ic Tessar f 4.5, 135 mm lens in Compur shutter, Bausch and Lomb 6 volt, 108 watt concentrated filament lamp with focusing achromatic condenser, and a Weston Master photronic exposure meter model 715 No. 1565033. Films used were Eastman Microfile, Eastman High Contrast Safety Positive, Panatomic-X, Plus-X, Agfa Finopan, and Kodachrome type A, all in 35 mm size. Microfile and High Contrast Positive film were developed in D-11 and D-34 (Eastman formulae). Panatomic-X, Plus-X, and Finopan were developed in Eastman D-76, and Champlin No. 17. The developing times and temperatures were those recommended by the Eastman Kodak Company and by Mr. Champlin. The time-temperature-tank method of developing with continuous agitation, was used throughout; the variation in developing time was ± 30 seconds and the variation in temperature during development was $\pm 0.5°C$. Some batches of the D-76 and D-11 were compounded by the manufacturers. The D-34, Champlin No. 17 and some batches of the D-76 and D-11 were compounded by the writers from c.p. materials, and weighed to an accuracy of ± 0.01 gms per liter of stock solution. Distilled water with a pH of 7.0 was used throughout. All exposures were based on the ratings for tungsten light assigned the various films by the Western Electrical Instrument Corporation.

DISCUSSION

It is known that a lens of given effective diameter and focal length, i.e., of a given f number, will transmit a given quantity of light per unit time, depending on the intensity of the light emanating from, transmitted by, or reflected from the object on which it is focused, and the distance of the lens from the object. An image of the object is formed somewhere behind the lens by the light passing through the latter according to the formula $1/p + 1/q = 1/f$, where p is the distance of the object from the lens, q is the distance of the image from the lens, and f is the focal length of the lens (Rockwell, 1941).

When an object on which a lens is focused is at a great distance in terms of the focal length of the lens, the image approaches the principal

focus, and a very real relationship exists between the light coming from the object and the intensity of the image. If this were not true it would be impossible to read accurately exposures with a light meter directly in terms of light intensity, effective lens aperture, and film speed. In other words, it requires a given quantity of light (energy) to produce a latent image on a film of given sensitivity, which upon development will yield a negative of given density. The preceding statement is the thesis on which the experiments were based.

Quantity of light is measured in terms of intensity and time in relation to the sensitivity of the film, but the intensity of the image is measured rather than the intensity of the light from the object before it enters the lens.

The amount of light energy necessary per unit area of film to produce a negative of optimal density is a constant for a film of given sensitivity. It follows that this constant is independent of the mechanism used for the production of the image, and is therefore independent of the magnification of the image. Therefore, it should be possible to measure the light intensity of an image, and translate this intensity into time of exposure in terms of film sensitivity. This should hold for any type of image producing mechanism, possibly excepting a spectrograph.

The object used in the experiments was a 7 x 9 inch ground glass screen behind which was a 75 watt General Electric Enlarging lamp. The light intensity at the surface of the screen was 1000 foot candles. A cross one centimeter high was ruled on the center of the screen with a hard lead pencil. A Leitz 50 mm f 3.5 lens in a Leica copying attachment with appropriate extension tubes was then focused on the cross so that a magnification of 1 x was obtained. The ground glass of the copying attachment was then removed and the Weston meter substituted. The intensity of the image was then measured for the entire series of effective apertures of the lens. The intensity of the object was checked frequently during the experiment. At f 3.5 the image intensity was 25 foot candles, at f 4.5 it was 16 foot candles, at f 5.6 it was 10 foot candles (Table I). Referring to the exposure meter it is seen that for an object intensity of 1000 foot candles and a lens set at f 3.5, a film with a 2.5 Weston rating (Microfile) would require an exposure of 1/250 second.

The calculator dial on the meter, however, is designed to compute exposures when the object is at a considerable distance from the lens. In the experiment just described the object is removed only twice the focal

length of the lens. Therefore, a correction must be introduced to compensate for the distance of the object from the lens. When this correction is applied, the true exposure time for an image intensity of 25 foot candles can be determined.

Referring to the formula $1/p + 1/q = 1/f$, and substituting the values of p and f used in the experiment, the formula becomes $1/100 + 1/q = 1/50$. Solving for q; $1/q + 2/100 - 1/100$. $q = 100$. Thus the image is 100 mm removed from the lens. The diameter of the lens remains constant, however, and since the f number of a lens is equal to the focal length divided by the diameter ($f = F/D$), the effective f number of a 50 mm f 3.5 lens when focused at twice its focal length becomes $2F/D$ or f 7. (Table I).

When the Weston meter is set with the pointer on the calculator opposite 1000 foot candles, and for a film speed of 2.5, it is seen that f 7 falls opposite 1/60 second. This is the actual exposure required for an image intensity of 25 foot candles and a film of 2.5 Weston.

As a more rigid check on the validity of these calculations a 135 mm Zeiss Tessar f 4.5 lens was focused on the object at twice its focal length, and the image intensities throughout its range of effective apertures were measured. These were found to fall on the same curve as the values obtained with the 50 mm lens focused in the same manner, moreover, the intensity values were the same for the same relative apertures of the two lenses. A preliminary exposure table was then constructed, by using the image intensities obtained with the two lenses through their series of effective apertures, and assigning exposure times as indicated by the Weston meter at twice the marked effective aperture on the lenses.

A photomicrographic apparatus was then set up using the equipment described previously. Critical illumination was employed, using the Köhler technique, as well as the method described by Allen (1941). The test objects varied from diatom shells to longitudinal sections of pine wood stained in safranin and fast green showing bordered pits in tracheids, and from living *Vorticella* to meiotic figures in *Ascaris* ova, stained with iron-haematoxylin. The image was carefully focused on the ground glass of the copying attachment. The ground glass was then removed, the Weston meter substituted, and the intensity of the image was measured. The camera was then slipped into place. Referring to the preliminary exposure table, the exposure was determined with the intensity of the image and the Weston rating of the film. A range of magnifications from 45 x to 1300 x were employed, and a wide range of

objectives and oculars, as well as ocular-image distances were used, to give the table as rigid test experimentally as possible.

The first roll of film (Microfile) so exposed yielded negatives which were consistent in density, but were slightly under-exposed. A careful check showed that background light had entered around the edges of the image, and had given readings too high. After adjustment of the magnification of the image so that the image completely filled the photocell of the meter, the resulting negatives were properly exposed.

Use of the preliminary exposure table revealed that there were not enough values for light intensities of the image to cover the range encountered in taking photomicrographs. Reference was again made to the calculator dial of the exposure meter, and to the low scale of light intensities. Setting the pointer on 1000 foot candles, and the emulsion speed on 2.5, f 7 (representing an image intensity of 25 foot candles) falls opposite 1/60 second. At f 9 (twice f 4.5) the image intensity was 16 foot candles, and the exposure indicated for f 9 is 1/40 second. Between 1/60 and 1/40 second on the calculator dial is 1/50 second, and between 25 and 16 on the low light intensity scale is 20 foot candles. Thus an image intensity of 20 foot candles would require an exposure of 1/50 second with an emulsion rated 2.5 Weston. The light intensities and exposures falling between the series determined experimentally (Table I) were obtained in this fashion, and form the body of Table II. They were checked photomicrographically, with films of the emulsion speeds given in order to prove their correctness. In all, about 250 exposures were made, using Eastman Microfile (Weston 2.5), Eastman High Contrast Positive (Weston 1.0 as determined by the writers), Panatomic-X (Weston 16) Plus-X (Weston 24), Agfa Finopan (Weston 16) and Kodachrome Type A (Weston 12) films. With critical illumination, and adjustment of the image so that the photocell of the meter is filled by the image when the intensity is measured, the method yielded properly exposed negatives. It is apparently accurate enough to yield excellent Kodachrome transparencies as well.

Summary of Method

1. Set up photomicrographic outfit. Obtain critical illumination.
2. Focus sharply on the ground glass screen of the photomicrographic camera, at the same time adjusting the magnification so that the image when focused completely fills the photocell of the exposure meter. If this is impossible, an increase in exposure time is necessary, and must be determined experimentally.

3. Remove focusing screen (ground glass) and substitute the exposure meter.
4. Read the intensity of the image in foot candles, using the low scale of the Weston meter.
5. Refer to Table II. In the left hand column, find the light intensity of the image determined by the meter. Follow across the table to the column of figures headed by the Weston emulsion speed of the film being used.
6. This is the exposure to be given, in seconds, or fractions thereof.

Example: The meter reveals an image intensity of 6.5 foot candles. A film with an emulsion speed of 16 is being used. Across from 6.5 one finds 1/100 second in the column headed by 16. 1/100 second is the exposure to use.

It is always a good practice in photomicrography to use the longest exposure practicable within the limits of the subject being photographed. This calls for some means of regulation of the intensity of the light source. The reasons for long exposures are too numerous to mention here (see Allen, 1941), but should be kept in mind, despite the fact that some of the exposures listed in Table II are quite short.

CONCLUSIONS

An attempt has been made to devise a method by which photomicrographic exposures may be determined simply without a tiring amount of preliminary experimentation. All of the variables which enter into the determination of such exposures were taken into account. Variation in shutter speeds of apparatus, as well as slight differences in transmission values of lens systems may alter the exposure values slightly. It is felt, however, that the method presented, together with the table of exposures using image intensities and Weston emulsion ratings may prove a saver of both time and film for those who previously have relied chiefly on the trial and error method of photomicrographic exposure determinations. The method will also enable others to easily determine exposure times for different films or plates, and construct their own exposure tables.

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TABLE I.

Light intensity of the image of an object transmitting 1000 foot candles light intensity, in relation to the f number of the lens, and the actual f number when focused at twice the principal focus of the lens. Values are determined experimentally.

f,(F/D)	2f,(2F/D)	Light intensity of image in foot candles
3.5	7	25
4.5	9	16
5.6	11	10
6.3	12.6	8
8	16	5
9	18	4
11	22	3.2
12.7	25.4	2.5
16	32	1.3
18	36	1.0
22	44	0.8
32	64	0.32

TABLE II.

Length of Exposure based on Intensity of Image and Weston Film Rating.

Weston Ratings	.5	1	2.5	4	6	8	12	16	24
Image intensity in foot candles	EXPOSURES IN SECONDS								
50	1/25	1/60	1/130	1/200	1/300	1/400	1/600	1/800	1/1200
40	1/20	1/50	1/100	1/150	1/250	1/300	1/500	1/600	1/1000
32	1/15	1/40	1/80	1/130	1/200	1/250	1/400	1/500	1/800
25	1/12	1/30	1/60	1/100	1/150	1/200	1/300	1/400	1/600
20	1/10	1/25	1/50	1/80	1/130	1/150	1/250	1/300	1/500
16	1/8	1/20	1/40	1/60	1/100	1/130	1/200	1/250	1/400
13	1/6	1/15	1/30	1/50	1/80	1/100	1/150	1/200	1/300
10	1/5	1/12	1/25	1/40	1/60	1/80	1/130	1/150	1/250
8	1/4	1/10	1/20	1/30	1/50	1/60	1/100	1/130	1/200
6.5	1/3	1/8	1/15	1/25	1/40	1/50	1/80	1/100	1/150
5.0	2/5	1/6	1/12	1/20	1/30	1/40	1/60	1/80	1/130
4.0	1/2	1/5	1/10	1/15	1/25	1/30	1/50	1/60	1/100
3.2	2/3	1/4	1/8	1/12	1/20	1/25	1/40	1/50	1/80
2.5	4/5	1/3	1/6	1/10	1/15	1/20	1/30	1/40	1/60
2.0	1	2/5	1/5	1/8	1/12	1/15	1/25	1/30	1/50
1.6	1¼	1/2	1/4	1/6	1/10	1/12	1/20	1/25	1/40
1.3	1½	2/3	1/3	1/5	1/8	1/10	1/15	1/20	1/30
1.0	2	4/5	2/5	1/4	1/6	1/8	1/12	1/15	1/25
0.8	2½	1	1/2	1/3	1/5	1/6	1/10	1/12	1/20
0.65	3	1¼	2/3	2/5	1/4	1/5	1/8	1/10	1/15
0.5	4	1½	4/5	1/2	1/3	1/4	1/6	1/8	1/12
0.4	5	2	1	2/3	2/5	1/3	1/5	1/6	1/10
0.3	6	2½	1¼	4/5	1/2	2/5	1/4	1/5	1/8
0.25	8	3	1½	1	2/3	1/2	1/3	1/4	1/6
0.20	10	4	2	1¼	4/5	2/3	2/5	1/3	1/5
0.16	13	5	2½	1½	1	4/5	1/2	2/5	1/4
0.13	16	6	3	2	1¼	1	2/3	1/2	1/3
0.10	20	8	4	2½	1½	1¼	4/5	2/3	2/5

Publishers' Requirements for Prints for Publication

by Aaron Stephenson, Jr.*

IN PREPARING illustrative material for publication, it frequently happens that the work is returned because it is not of the correct size, proportion, finish or because it is not mounted properly. A survey was attempted to aid in the solution of this problem. It was found, however, that the various publishers had different requirements.

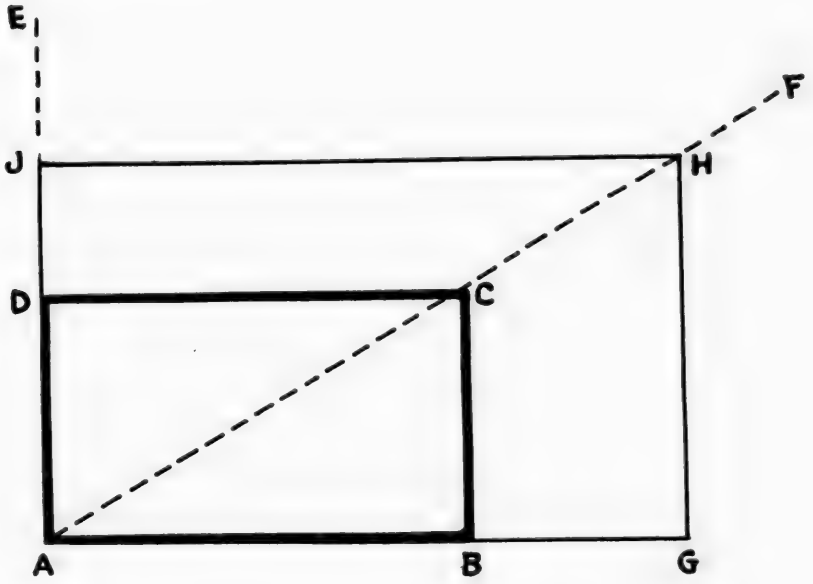
For the sake of comparison twenty-two publishers in the United States and England were asked to furnish a list of their requirements and to send samples that might be used for display purposes. Fourteen answered; five of these furnished data which could be used but only one supplied all of the information requested. However, from the information supplied by this one, and from bits gathered from the others some helpful suggestions were obtained.

The single publisher mentioned, the Wister Institute of Anatomy of Philadelphia, not only answered all of the questions, but sent an abundance of material from which a display was arranged and shown at the BIOLOGICAL PHOTOGRAPHIC ASSOCIATION convention in Philadelphia.

In general, these rules will apply to material submitted for reproduction: Most publishers ask for glossy prints, some suggest a brownish tone. Most of them will accept a semi-matte finish, while a few request this finish. The prints should be shipped flat, untrimmed and unmounted, for many publishers prefer to group the prints in such a way as to economize on the cost of engraving. They request the originals of line drawings for they claim photography introduces tone into the blacks which is lost in the zinc line engraving. They do suggest, however, that photographs be made of the originals as a precautionary measure in case of loss or damage. Several publishers suggest that they can arrange to

* Received for publication October 15, 1941. Johnson Foundation and Harrison Dept. of Surgical Research, University of Pennsylvania, Philadelphia, Pa.

supply the lettering which is to appear on the print. Material for the halftone and fulltone reproduction should be perfect, as all blemishes will show, thus requiring very expensive routing by the engraver. Extra contrast is no longer needed by most publishers as the processes have been perfected to a point where very little detail is lost. Whites should be as white as possible. Prints should be submitted one-third or more oversize. A suggestion which came from the Wister Institute for a simple method of determining the reduction of prints for publication is shown in the diagram below.



The rectangle ABCD is the size of the available space on the page or size desired in the final reproduction. In order to determine the exact size of the print you are to make when it is to be reproduced one-third off, the line AB is increased by half its length to G. The diagonal AC is extended indefinitely to F, and AD is extended to E; a perpendicular to the line AG is drawn from G to intersect the line AF at H; and a parallel to the line AG is drawn to intersect AF at H, thus forming the rectangle AGHJ the size of the required print.

If a manuscript has a number of illustrations and it becomes necessary to reduce the cost, the prints may be grouped on single or double

pages at a considerable saving in the cost. If the double page is used, it is advisable to group the figures so that the fold of the page does not cut through any one of them. The desired reduction or size of the final reproduction must be stated or the publisher will use his own judgment. All prints should be thoroughly identified on the back. It is a good policy for the photographer to indicate to the author the best method of supplying the publisher with the necessary information regarding the photograph as a print can be ruined easily. The best suggestion for marking is to place the print face down on glass or some other smooth, hard surface, and with a soft pencil mark lightly on the back so that the front surface is not marred. Where there might be any doubt as to the top and bottom of the print, it should be indicated.

Because the instructions for the preparation of illustrations in color vary so much, it is best to consult the individual publisher.

The comments listed above, constituting the more important suggestions for the preparation of prints, were taken from the replies received from publishers who cooperated by supplying data. By following these suggestions satisfactory results will be obtained.

1942 CONVENTION

At the time of our annual meeting last year no decision was made regarding a city for the 1942 convention. It was believed that the prevailing conditions were so unsettled that a later decision would be more practicable. The directors have now voted to hold the annual meeting and convention in New York City. Most of our attending members are located in that area so this is in accord with present efforts to curtail travel. The meeting dates will probably be September 10, 11, and 12.

Plans for the program are now being made and members having papers for presentation should communicate with the secretary as soon as possible. Many of the papers which appear on the program are later published in the JOURNAL so readers are invited to suggest subjects which they would like to see in print.

Announcements will be mailed to all members when the arrangements are nearer completion.

Faults in Photomicrography*

by John V. Butterfield†

AT THE present time the average reader encounters many reproductions of photomicrographs illustrating various things, ranging from a point of superiority of an advertised everyday product to some new microorganism discovered to be responsible for a malady long a source of fear to many, the workings of which are known only to those highly versed in the biological sciences.

Although it is not necessary for the user to be thoroughly familiar with the technicalities of the lenses in his microscope nor the theories of image formation, etc., which are of interest chiefly to the optician who made the instrument, there are a few of the fundamental principles which are important to the intelligent use of the microscope.

Frequently, however, one is apt to lose sight of even these simple rules. In an effort to save valuable time in recording microscopic observation, more time may be consumed than need be, or the resulting picture may suffer in certain respects, so that while it may pass for the time it still has the appearance of something that could have been done better.

It is hoped, therefore, that the points mentioned in the following paragraphs may be of assistance to the reader in clearing up some of the difficulties encountered in photography with the microscope.

The subject used in the accompanying figures (a section of corn stem stained with Cyanin and Erythrosin) was not chosen as a subject particularly susceptible to the faults to be mentioned. The specimen was merely picked at random from a collection of slides.

Of the factors contributing to the production of a successful photomicrograph, the most important is the alignment of the illuminator, microscope and camera. The time required to make certain that the equipment is properly set up is amply repaid by the results. Except in a few special cases, the arrangement of the system remains unchanged and only by the correct relationship of the component parts is it possible to make full use of the resolving power of the microscope objective. After all, the reason for using a microscope is not just to make things

* Reprinted from "The Educational Focus," courtesy of Bausch and Lomb Optical Company.

† Received for publication March 9, 1942 from John V. Butterfield, Scientific Bureau Department of Engineering, Bausch and Lomb Optical Company.

look bigger, but to separate the fine details of the specimen we wish to examine.

Once the apparatus is correctly aligned so that the specimen is critically illuminated, not only are the best photomicrographs obtained, but the conditions are ideal for visual observation as well.

Figure 1 represents a type of fault that occurs frequently; an uneven distribution of light throughout the field with poor definition over most of the specimen, and consequent variation in contrast. Although uneven densities in the negative may arise from the negative processing, in most cases the fault lies in the illumination.

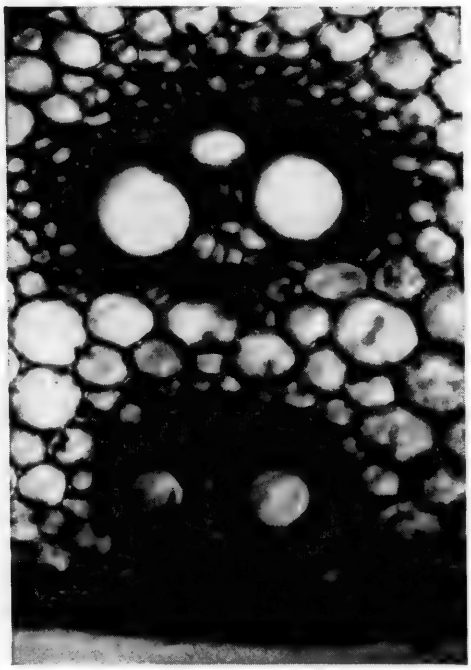


Figure 1. Uneven Illumination.

If the photomicrographic equipment is in a horizontal position, it is essential that the light source and condenser, the microscope and the camera are lined up on a common axis. If the microscope is used in a vertical position, it is necessary to have the camera axis coincident with the microscope axis and the microscope mirror adjusted so that the axis of the illuminator, after reflection, is also coincident with the axis of the microscope and camera.

The fact that the field of view appears to be evenly illuminated, either in the microscope eyepiece or projected on the ground glass screen, is not sufficient proof that the specimen is correctly illuminated.

Most photomicrographic apparatuses employ the Kohler method of illumination. In this system the lamp condenser is focused to form an image of the light source in the plane of the substage condenser lens. The distance from lamp to substage must be great enough to permit a magnification of the source sufficient to cover completely the full aper-

ture of the substage condenser. This is accomplished by focusing the lamp condenser to throw the image of the bulb filament on a piece of paper held against the microscope condenser. Since the depth of this focus is considerable, it will not matter if the substage is moved slightly after this adjustment.

The substage condenser in turn is then focused to form an image of the lamp condenser or its iris diaphragm in the plane of the specimen on which the microscope is focused. The method followed in doing this is to focus roughly on the specimen, using on the microscope the eyepiece, objective and condenser components which will be employed when making the picture. The lamp diaphragm is closed part way or some object is temporarily placed against the lamp condenser to serve as a silhouette on which to focus. While watching the ground glass of the camera, the microscope substage is racked back and forth until the diaphragm or object is as sharp as possible in the field of view. The lamp diaphragm is then opened to just clear the field, or the temporary focusing aid is removed. If these conditions are met and the lamp and microscope properly aligned, the field of view will be evenly illuminated. The lamp condenser or the area immediately in front of it is evenly filled with light and this aperture is imaged directly on the specimen. At the same time, assuming that the substage condenser in use is of sufficient aperture for the microscope objective, the light rays entering the objective will be converging at the greatest angle accepted by the objective, so that the full numerical aperture and, hence, the full resolving power of the objective may be used.

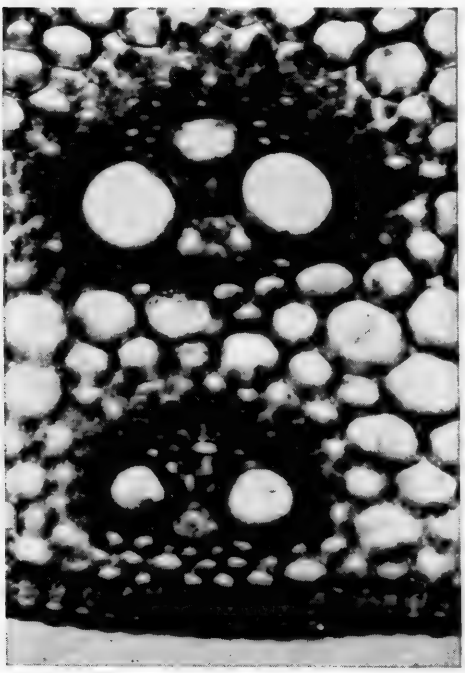


Figure 3. Low Aperture.

To check this latter condition one may examine the aperture of the objective by looking down the center of the microscope body tube at the back lens of the objective after removing the eyepiece. What one should see is the back lens fully and evenly filled with light when the iris diaphragm under the substage condenser is wide open, and a homogenous source of light is used. With a coil filament lamp, for example, an image of the hot filament coils should appear. The image of the coils should be magnified so that they are evenly distributed over the aperture. It should be mentioned that it is practically impossible to obtain absolutely critical illumination with the *coil* filament lamp. The incandescent tungsten bulb of the *ribbon* filament type, such as used in the Bausch and Lomb Research Lamp, permits critical illumination to be obtained.

The photomicrograph in figure 1 was made with the illuminant improperly aligned with the microscope. The field as observed in the microscope eyepiece was not noticeably uneven, but the photographic plate is much more sensitive to variations in ilumination than the eye. Hence, the final picture is a complete failure.

Removing the eyepiece and observing the aperture of the objective, as outlined previously, revealed the condition shown in figure 2. The illuminated disc is the aperture of the rear objective lens, (approximately the back focal plane of the objective.) It will be noticed at once that only the lower half of the aperture is filled by the image of the light source — in this case, a ribbon filament. The upper half of the aperture is illuminated only by the light diffused within the specimen.

To remedy this situation with the horizontal type of setup, the substage condenser must be centered with the axis of the microscope; then the height and tilt of the illuminator adjusted until its axis is common with that of the microscope, at the same time making certain that the lamp filament is centered with respect to its condenser lens. When these conditions are met, the aperture of the objective should appear as an evenly luminous disc with or without the specimen slide in place.

This fault in illumination is frequently encountered in setups where the microscope and camera are vertical. Although the field of view seems well illuminated and the iris at the lamp, or a pointer at the center of the lamp condenser, may be imaged by the substage condenser at the center of the field, the path of light from the lamp through the objective may not be a straight line. The vertical type of setup is made rather flexible by the microscope mirror, so that the mirror is frequently tilted to center the illumination, instead of centering the substage con-

denser or adjusting the lamp, with the result that the image of the light source is thrown off the center of the substage condenser.

In either case, it is generally possible to detect improperly adjusted illumination, even when the aperture of the objective appears to be filled. If the light is passing through the specimen obliquely, the image of the specimen appears to drift sideways as the objective is focused up or down. When the system is properly aligned, points in the structure of the specimen should remain stationary and, as the objective is focused through them, the points should appear to expand symmetrically.

When the microscope mirror is set at the correct angle, the light reflected from the surfaces of the substage condenser is thrown back onto the lamp condenser. If the microscope is fitted with a centerable substage, the mirror should be tilted until the light reflected from the condenser surfaces can be picked up on a card held near the lamp. Tilt the mirror carefully until the spot of light is thrown directly back on the lamp condenser. Leaving the mirror in this position, center the substage condenser to bring the image of the lamp condenser on center in the field of view. Check the tilt of the mirror again and, if necessary tilt to compensate for the shift in the substage condenser. When these adjustments are made, the image of the light source should fall squarely in the microscope mirror and then be reflected centrally into the substage condenser. If the image of the light source is not centered on the microscope mirror, the lamp should be adjusted for height and tilt to bring about this condition. It is necessary then, of course, to change the tilt of the mirror and recenter the substage condenser slightly. After these adjustments, the aperture of the objective, as well as the eyepiece field, should be evenly illuminated.

A fault that appears in many photomicrographs, probably more frequently than uneven illumination, is the result of incorrect use of the objective aperture upon which resolution depends. This may result from either of two things. First, improper use of the iris diaphragm in the substage, or secondly, incorrect adjustment of the substage condenser. It is not alone sufficient to know that the illuminator, microscope, and camera are all in line.

The iris diaphragm in the microscope substage is one of the most misused pieces of microscope equipment. It is designed primarily to fulfill the same function as the iris in a photographic objective and was never meant to be used merely to reduce the brilliance of illumination, yet many times it is used for just that.

The important thing to be remembered in regard to the substage diaphragm is its limiting effect upon the aperture of the substage condenser with which it is used. The numerical aperture of any lens is practically the ratio of half its diameter to the focal length. It follows then that closing the iris diaphragm in effect reduces the diameter of the lens. Consequently, the numerical aperture of the condenser is likewise reduced. Reducing the working aperture of the substage condenser effects a reduction also in the aperture (and hence the resolving power) of the objective in use with it.

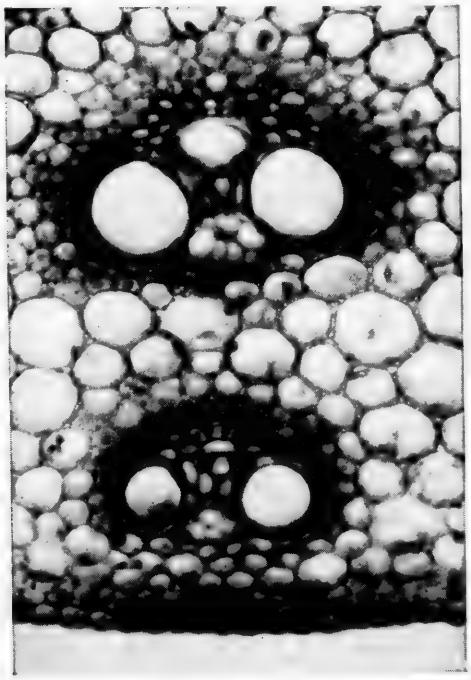


Figure 6. Correct Illumination.

It can be demonstrated that an image formed by a lens of a mathematical point cannot be another point but, due to the finite wave length of light, becomes instead a diffused disc of some size, referred to as the circle of confusion. The numerical aperture of the lens system is an important factor in determining the size of the circle of confusion so that as the aperture is reduced the disc of light becomes larger. Considering the structure within a specimen as made up of a multitude of points each of which is represented in the image by a disc of light, appreciable reduction in aperture produces an overlapping with the result that the image becomes fuzzy. As the circle of confusion is actually a diffraction phenomenon, further reduction in aperture produces diffraction bands about all parts of the structure in the specimen, so that it may be difficult to determine with certainty the actual structure of the specimen.

Figure 3 represents the effect produced on our section after realigning the illuminating system, but with the substage diaphragm reduced to a rather small opening. Several points of interest may be noted.

Although the illumination is even and the oblique illumination effect is gone, the detail in the vascular bundles is almost completely wiped out. In figure 1 the detail is fair in certain parts where the contrast is not too great. In figure 3 the contrast in general is too high, the cell walls throughout the section are thick and appear double. Detail in the epidermis and primary cortex is entirely lacking, while the magnification in this figure would seem to be actually greater than in figures 1 and 6.

Figure 4 is a photograph showing the aperture of the rear lens of the objective as it appeared when figure 3 was made. Here a scale has been introduced to show the portion of the available aperture in use. The central bright spot shows the amount of aperture illuminated by the substage condenser. The image of the substage iris can be discerned. The rest of the aperture is feebly illuminated by the light diffused within the specimen. Due to this diffused light, the objective is actually working

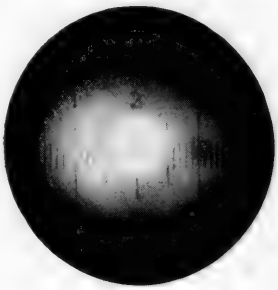


Figure 4.

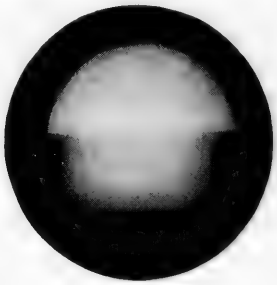


Figure 2.

Figure 5.

at an aperture somewhat greater than that supplied by the condenser.

The question left to be answered then is, "To what extent can the substage diaphragm be reduced?" It is difficult to arrive at any set limit in this respect, for it will be found to vary, depending somewhat on the type of specimen to be photographed. From regular practice it has been found that usually the best results are obtained when the working aperture of the objective is reduced by not more than one-third of its full value. In other words, removing the microscope eyepiece and looking down at the back lens of the objective, at least the central two-thirds of the lens aperture should appear to be evenly illuminated by direct rays from the substage condensers, while about the periphery of the lens appears a zone illuminated only feebly as previously explained. The width of this zone should be about equal to one-sixth of the lens diameter. This condition is illustrated in figure 5.

In most cases one-third reduction in aperture is probably all that is permissible. If it is necessary to reduce aperture at all, one should be careful not to reduce the substage diaphragm to the point where diffraction bands appear about the structure in the specimen.

Use the iris diaphragm for the purpose for which it was designed. If it is necessary to reduce illumination to permit comfortable observation, do not close down the iris. Instead, insert neutral filters in front of the lamp or reduce the intensity of the light source.

The working aperture of the objective, as we have indicated, may be affected by the adjustment of the substage condenser. The substage condenser serves to illuminate the specimen with light, and at the same time, converge the light at an angle as great as that taken in by the objective so that the resolving power of the objective may be utilized. If the objective in use is of low power, the numerical aperture will also be relatively low and the field of view large in proportion. If a high aperture condenser is used, say the entire substage condenser, its focal length is necessarily very short. As a result, the image of the lamp condenser when focused on the specimen plane is small, too small to fill the field of the lower power objectives, while the numerical aperture available is greater than that taken in by the objective. Under such circumstances, the condenser is often racked up or down until the field is fully illuminated without regard to what happens to aperture. This is a practice to be avoided if possible. There is a very short range through which the substage condenser can be focused without appreciably affecting critical illumination, but this slight amount of adjustment is usually not sufficient to produce the effect desired. The result is usually a loss in resolution due to a restriction in numerical aperture just the same as if the substage diaphragm has been closed down too far.

Most substage condensers are of the divisible type and may be separated into two or three parts. The lower element is usually designed to illuminate the field and aperture of the lower power objectives. With the second element added the aperture and focal length are correct for the intermediate objectives. The entire unit is used, of course, for the high aperture dry objectives and the oil immersion objectives.

Making a new exposure with the objective illuminated, as shown in figure 5, that is, with the aperture of the objective working at a reasonable value, gave the results shown in figure 6. The improvement in detail over figure 3 is at once apparent. Compare the structure in the vascular bundles in figures 1 and 3 with the same areas in figure 6 and

the picture would hardly seem to have come from the same specimen, yet the section, optical elements and photographic material were the same in each case. The exposure time varied due to the differnc in condition of illumination.

It follows, then, that in order to apply photography to the microscope it is essential that at least the fundamentals of microscopy are adhered to in order to make our photomicrographs tell the whole story. There are faults that may come from improper use of the photographic materials, but the most careful use of the best of these is of little value, if careful use is not also made of the optical system involved.

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Luminography

by T. Benedek, M.D.*

HISTORICAL INTRODUCTION

The knowledge and the utilization of Wood's light (the "strange light" of Mr. Wood as Nogier[1] put it) came to our attention in this country rather late, particularly as to its use for mycological purposes. Strange to say, the epoch making discovery of R. W. Wood had to come to us by way of France, despite the fact that the discoverer, R. W. Wood, was an American physicist at Johns Hopkins University at Baltimore, at that time already of world renown.

During the World War I Wood served over seas with the AEF, making investigations into ultra-violet light of high intensity as beacons and for secret signals in war-time. A complete disclosure of the method of producing what is now called "black light," and a description of its properties and possible uses could not be made during the hostilities. After the armistice, however, R. W. Wood made his investigations public in a communication published in the French Journal de Physique[2] in March 1919.

In this publication, R. W. Wood, mentioned the strange fluorescence of the corpus vitreum of the eye-ball (grayish or bluish-white), the striking bluish-white color of normal teeth and of the nail plates, the complete blackness of false teeth, the pale-gray fluorescence of the white skin (1.c.p.86). And further he added: "The question would be worthwhile to be studied by physiologists and pathologists (1.c.p.88)".

Due to the strange place of publication (Journal de Physique) of a rather hidden remark concerning biological potentialities of a physical discovery, the knowledge of Wood's work reached this country a decade later and even at this time by a detour through England. Herman Goodman of New York[3] was the first to realize the still hidden potentialities of the "strange light" of Wood and his article appeared in the British Journal of Dermatology in 1928. This author subsequently made several contributions to the subject[4,5,6].

In the meantime, however, French biologists and shortly afterwards French dermatologists took early notice of Wood's discovery. In 1923

* From the Laboratory for Mycological Research, Department of Dermatology, Chairman: Edward A. Oliver, M.D., Northwestern University Medical School and from the Salvation Army Free Dispensary, Territorial Headquarters, Medical Director: Alfons Bacon, M.D., Dermatological Service: T. Benedek, M.D., in Chicago, Illinois.

Pech installed in his laboratory at Montpellier a quartz lamp with Wood's filter and called the attention of the medical world to the possible applications of this special light in biology[7]. His call was heeded very soon.

J. Margarot and P. Devèze had already given a short paper on their preliminary experiments with Woodlight, in July 1923, in the Biological Society at Montpellier. Two years later, 1925, they first published the results of their assiduous investigations [8]. This communication was the first to record fundamental observations made by means of the Woodlight in Dermatology. The credit thus goes to Margarot and Devèze to have called the attention of dermatologists to Wood's epoch making discovery.

Margarot and Devèze (1925, 1929),[8,9] Paul Vigne (1927)[10] have established the great value of Wood's light as a paramount diagnostic tool in certain mycotic infections of the scalp. They observed that Microsporum, Favus and Trichophyton infected hairs on the scalp show a green fluorescence, using filtered ultra-violet radiation with the peak at wavelength 3650A.

After the basic observations of these French authors a flood of publications followed with substantiation of R. W. Wood's original discovery and duplication of the findings of the French workers.

Nogier (1925, 1927)[11,12], Jausion and Giard[13], Gougerot, Giraudeau and Patte (1939)[14] in France, Roxburgh (1927)[15], Sibley (1927)[16] in England. Redaelli and Cortese (1930)[17] in Italy. Bommer (1926)[18], Ph. Keller (1926)[19], Mallinckrodt-Haupt (1934, 1935, 1936)[20-22], in Germany, Cleveland (1928)[23]. Davidson and Gregory (1932, 1933, 1934) [24 to 28] in Canada, Lewis (1935)[29,30], Lewis and Hopper (1936)[31], in this country deserve special mention among the early contributors.

THE FIRST ATTEMPTS AT LUMINOGRAPHY: PHOTOGRAPHY WITH ULTRA-VIOLET LIGHT†

The idea of attaining a permanent record of the strange fluorescence of the fungus infected area of the scalp came up very early.

Margarot and Devèze in 1925 expressed their hope of obtaining pictures of the fluorescence. The difficulties, however, were no doubt considerable and the authors do not even mention this matter in subsequent, more comprehensive publication (1929).

In the same year (1925) I. Meyer and Saidman[32] mention efforts

† The modern scientific term for photography of fluorescing objects with an ordinary camera is "luminography." Its product is a "luminograph" in contradistinction to a photograph, a product of visible light. (Cf. radiograph: a picture produced by X-rays.)

in this direction stating that "the photography of these (fluorescent) phenomena encountered very great difficulties with regard to the considerable length of time necessary to register the pale luster of fluorscence.

P. Vigne (1927) emphasizes, that "the photographs of these different fluorescences are very difficult to obtain, on account of the different sensibility of our eyes and the photographic plates to the luminous ultra-violet radiation." He, however, added, "we were able, nevertheless, to demonstrate a few (photographs) at the Dermatological Congress at Bruxelles in July 1926[33]." These photographs, however, were never published.

The only photographs of fluorescent phenomena due to mycotic infection published in print are contained in a communication of Davidson, Boyd, and Haltalin (1935)[28]. These are comparative photographs of hair and follicle without hair bulb in the early stage of infection by Microsporon felineum by (a) visible light, and (b) by ultra-violet light.

Despite thorough search of the literature, further reproductions of the brilliant fluorescence of mycotic infections of the scalp could not be found.

The usefulness of Woodlight for clinical and research study of certain dermatomycoses as demonstrated by luminography.

Diagnosis of fungus infections of the scalp meets very often with considerable difficulties, particularly, when it is desirable to determine how far the infection has already spread beyond one or several main foci. The dermatologist faces these harassing difficulties mainly in two groups of dermatomycoses, (1) microsporosis, and (2) trichophytosis of the scalp.

The keenest clinical scrutiny, the most painstaking and thorough microscopic examination of the hair of the scalp cannot solve this problem. However, ultraviolet radiation provides the physical means to detect even one single infected hair, as the writer has done frequently, at a time when the diagnosis of a fungus infection of the scalp would have been impossible by ordinary means. Weeks, maybe months, would have gone by before clinical signs of an infection would have become visible, and in the mean time this one source of infection would have spread the infecting agent widely.

The ultraviolet light is furthermore the best tool with which to watch the progress of therapy and to determine the successful eradica-

tion of the infecting agent which is epidemiologically of utmost importance.

The importance of ultraviolet light as a diagnostic tool is still too lightly considered even among specialists. There is only one substantial reason for this state of mind. An extensive search did not reveal any demonstration of the overwhelming advantages of ultraviolet radiation for this purpose. Hence, it is of paramount importance to convince those concerned, by pictorial means, of the advantages of ultraviolet radiation in making the diagnosis, in determining the progress of treatment and the definite final cure of the above-mentioned dermatomycoses of the scalp. Therefore it is important to demonstrate the superiority of luminography over photography.

As a diagnostic tool, ultraviolet light is used by dermatologists in the form of the so-called Woodlight.

In 1903 the American physicist Wood** suggested, a filter consisting of a solution of nitrosodimethylaniline which transmitted ultraviolet rays from a certain light source and excluded rays of the visible spectrum. The nitrosodimethylaniline solution absorbed the rays of the wavelength of 5000 A to 3700 A while it transmitted the rays of 3400 A to 2000 A. However, this filter allowed the transmission of a broader band of the visible spectrum. By means of combining the nitrosodimethylaniline gelatine film with cobalt glass, signal green glass and an uranin film, Wood succeeded in constructing a filter permitting the transmission of ultraviolet rays of the wavelength of 3400 A to 3300 A almost exclusively. The final commercial form of the "Woodfilter" was made up of a special barium-sodium-silicate glass incorporating about 9 per cent nickel oxide.††

Wood also made other important contributions to photography. He invented a new process of color photography by means of diffraction gratings. (Diffraction process of color photography, Science 9:859, 1899, Photogr. Journal 24:256-263, May, 1900.) He made the first photographs with an infra-red filter which showed distant mountains sharply outlined with all their high lights and shadows on days when the haze was so dense as to make them quite invisible to the eye. These

** Those who desire a better acquaintance with Robert W. Wood's life, inventions and discoveries may be referred to a biography published recently by William Seabrook, "Doctor Wood, Modern Wizard of the Laboratory," Harcourt, Brace & Co., New York, 1941.

†† A solution of nitrosodimethylaniline combined with dense cobalt-blue glass enabled R. W. Wood to make his first landscape and lunar photographs in ultraviolet light and at the autumn meeting of the National Academy at Baltimore in 1902, he gave an experimental demonstration of what could be done with what is now called "black light." (R. W. Wood: Screens Transparent only to ultraviolet light and their use in spectrum photography. Phil. Mag. 5:257-263, 1903.)

later photographs made in 1908 were the first infra-red pictures ever made. His best and most striking infra-red photographs were exhibited at the annual exhibition of the Royal Photographic Society in 1911 and published in the Illustrated London News. (Note on infra-red investigations with the echelette grating with A. Trowbridge. Phil. Mag. 20:898-901, and 770-778, 1910.)

The Woodfilter in its present form transmits a narrow band of ultraviolet light with the peak at 3650 A. By means of this Woodlight certain fluorescence phenomena can be produced. The emitted invisible ultraviolet rays strike certain objects and induce fluorescence, a visible phenomenon, since the shortwavelength ultraviolet rays are transformed to rays of longer wavelengths which give the subjective response of color.

Among the different dermatomycoses of the scalp, microsporum hair fluoresces with a beautiful, intense copper-green or emerald-green color. Trichophyton endothrix shows a faint pale blue hue, while favus hair is canary yellow.

Since microsporosis is the most stubborn and epidemiologically the most important communicable fungus disease of the scalp in childhood, a case of microsporum infection of the scalp in a white, blond boy, is presented to show the impressive differences of luminographs contrasted with photographs.

As known, there are two distinctly different ways of using ultraviolet rays for photography. One is the *"reflected ultraviolet method"* which is similar to ordinary photographic methods, the photograph being taken by the light reflected from the object. The other method, known as the *"fluorescent light method"* depends on the ability of ultraviolet radiation to induce visible fluorescence in certain materials.

In the case presented, the "reflected ultraviolet method" was used, the source of radiation being provided with a filter transmitting mainly the invisible ultraviolet with a narrow band of visible violet. An ultraviolet transmitting filter over the lens, for photography of fluorescent effects alone can not be used because of the unduly long exposure time. This is particularly important when dealing with young children whose heads, despite support, cannot be kept immobilized for twenty or more minutes.

Source of Ultra-Violet Light

A General Electric BH-4 mercury vapor lamp is used. The light is produced by a high pressure mercury arc in a small quartz tube

Figure 1. Photograph of B-H4 mercury vapor lamp outfit (Courtesy General Electric Co.).

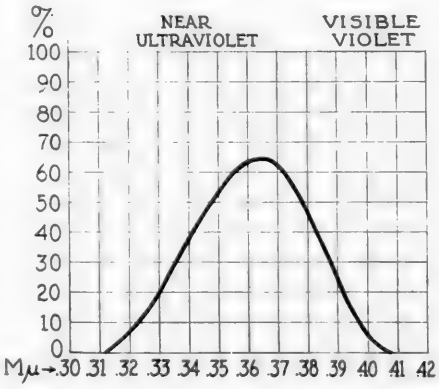


Figure 2. Transmission of Corning glass filter No. 587 represented by a spectrophotometric curve. (Courtesy Corning Glass Works).

mounted within a red purple bulb (Corning glass No. 587). This special Mazda bulb operates at 100 watts, 60 cycles, 115 volt, 2 amp. (Code No.: Sc-30-A3). The glass of the bulb itself is an ultraviolet transmitting filter. The bulb is screwed in a reflector like the Kodak Handy Reflector, (Figure 1).

This bulb emits ultraviolet radiation in the near ultraviolet, with the strongest line, the one most useful in photography 3650 A. It transmits a relatively narrow band of ultraviolet, extending roughly from 3000 A to 4000 A (Figure 2).

Camera

A 5" by 7" view camera was used with a Zeiss Protar lens of 18.5 cm focal length, stop at f/7.

Negative Material

Most photographic materials have their highest sensitivity in blue and violet, particularly the so-called ordinary or color-blind materials. The Eastman Orthochromatic Par Speed Portrait film was used with no success. The reason was that this film has a low resolution. Its resolving power is about 40 lines per mm.

Dealing with microsporum infection of the scalp a single infected hair is seen as a fluorescent streak, while a bald patch, due to the micro-

sporum infection, as a fluorescent sieve-like surface where the "holes" are represented by the fluorescent follicle openings. These facts indicated that a color-blind film with the highest resolving power available should be used. In this group there are films used for line copy work. Furthermore the highest contrast was necessary, because the contrast in the ultraviolet is lower than in visible light.

The final choice was Eastman Kodak High Contrast Safety Positive Film with a resolving power 70 lines per mm.

TECHNIC USED

The subject for this photographic experiment in ultraviolet was an eleven year old white blond boy. He was seated in a chair with neck support only, because he had the infection in the occipital region. A case affected in this region is chosen because it gives a fairly plane surface. On any other part of the scalp the curved surface would cause difficulties in focussing.

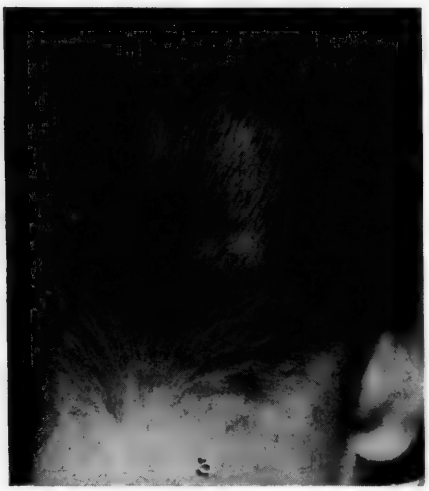


Figure 3. Microsporosis of the scalp; photograph taken in visible light, (two photofloods No. 2) lamp distance two feet, Eastman Kodak Orthochromatic Par Speed Portrait, Zeiss Protar, F: 18.5 cm, Filter Eastman K 2, exposure 4 seconds at f/7.—No sign of infection is visible.

Figure 4. Microsporosis of the scalp in the same individual; photograph taken in ultraviolet radiation, wavelength 3650 A, lamp distance 10 inches, Eastman Kodak High Contrast Safety Positive Film, Zeiss Protar 18.5 cm, exposure 1 minute at f/7.—Infected hairs appear light due to the reflection of ultraviolet radiation.

The ultraviolet radiation was directed exclusively on the infected area and the rim of the reflector was only ten inches from the scalp.

Since no filter was applied to the lens, the photograph was taken *in a totally dark room.*

Under the conditions given, the exposure time was one minute.

With a larger and more intensive ultraviolet source of radiation the exposure time could be materially reduced.

Figure 3 was taken in visible light (2 photofloods No. 2) on Eastman Orthochromatic Par Speed Portrait film. In this photograph, and by direct inspection of the scalp, the focus of infection could not be seen, much less the numerous single scattered hairs about the main focus.

Figure 4 was taken in ultraviolet light. Only the infected hair on the scalp will photograph in ultraviolet because it reflects this radiation. These appear light in the print, while the normal — not infected hair — absorbs this light and appears dark.

An easier demonstration of the advantage of the ultraviolet radiation in dermatomycoses may be accomplished independent of the patient. A few hairs are mounted between two clean slides, framing the latter with black lantern slide tape. In this way permanent preparations can be made for teaching purposes or demonstrations. This is also the most suitable method to demonstrate comparative hair-mounts, one beside the other, in a black wood frame which accomodates six framed slides.*

In photographs No. 5, 6, and 7, five comparative hair-mounts are shown, with normal and infected hairs. These photographs also reveal the importance of the proper negative material, i.e. films with high resolving power.

Photograph No. 5 shows the following hairmounts, the sequence of which is the same in Nos. 6 and 7.

From the left to the right frame: (a) blond hair with Trichophyton endothrix (Culture: Tr. crateriforme).

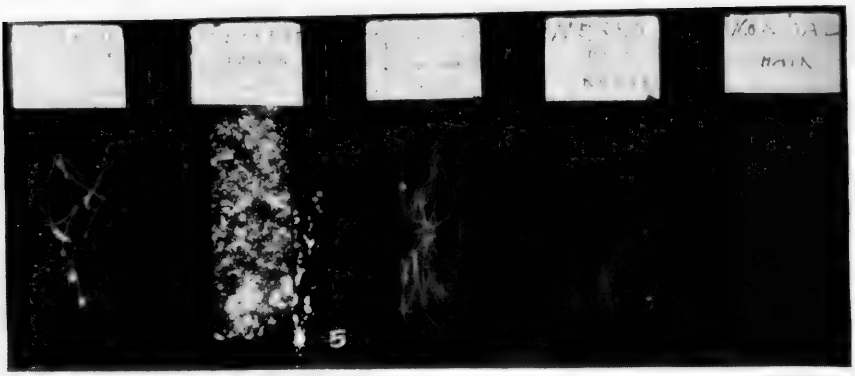
(b) Blond hair and scales from seborrhea sicca capitis.

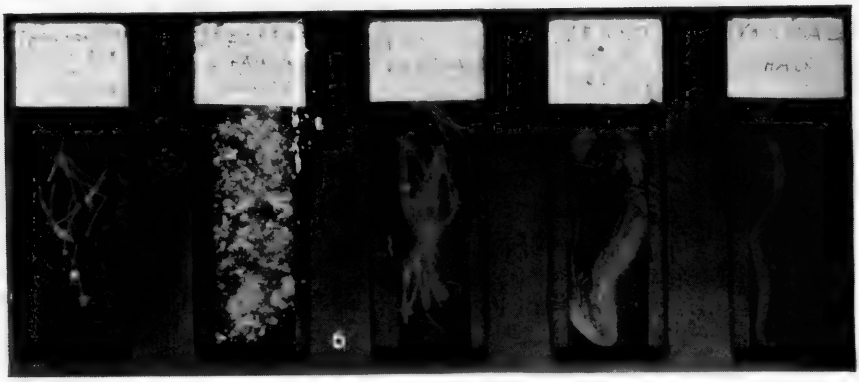
(c) Blond hair with Microsporum (Culture: M. Audouini).

(d) Normal negro hair with grease.

(e) Normal brunette hair from a white person.

* Behind these slides photographic black paper is placed to bring out the fluorescent effect. By experiment this was found to be the best method.





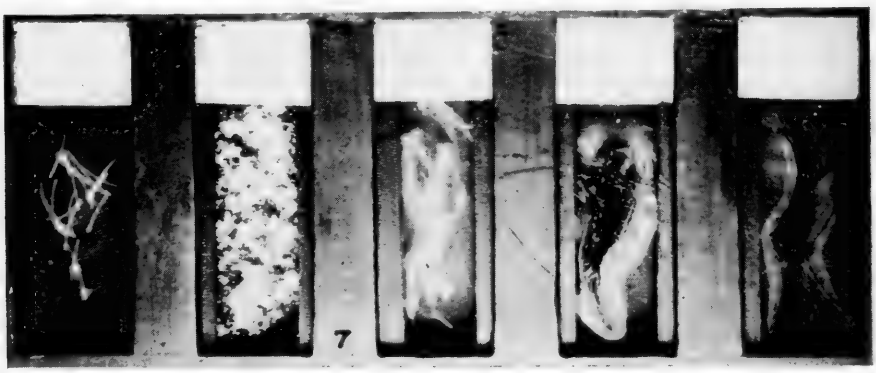


Figure 5.—Comparative PHOTOGRAPHS *of hair-mounts of fungus infected and normal hairs. Details in the text. Photograph taken in* VISIBLE LIGHT. *One photoflood No. 2, distance 20 inches, exposure time 2".* FILM*:* EASTMAN ORTHO PAR SPEED PORTRAIT.

Figure 6. Comparative LUMINOGRAPHS *of hair-mounts of fungus infected and normal hairs. Details in the text. Photograph taken in* WOODLIGHT. *Distance of reflector rim 10 inches, exposure time 1 minute.* FILM*:* EASTMAN ORTHO PAR SPEED PORTRAIT.

Figure 7. Comparative LUMINOGRAPHS *of hair mounts of fungus infected and normal hairs. Details in the text. Photograph taken in* WOODLIGHT *Distance of reflector rim 10 inches, exposure time 1 minute.* FILM*:* EASTMAN HIGH CONTRAST POSITIVE FILM.

Frames (a) and (c) show groups of blond hair, sharp, well defined with a few scales on the hair. Frame (b) is of special importance. Severe cases of patchy seborrhea sicca capitis may be encountered in which there is doubt clinically whether the condition involves microsporosis. Microscopic examination is of little help, because even in microsporosis it may happen that a healthy hair was selected for inspection. It has been repeatedly found, that Woodlight in such a case is of great help in clarifying the diagnosis. The seborrhoic scalp shows a dull chalky white fluorescence, there are no sparkling colors as in microsporosis.

Furthermore it is important to know the fluorescent characteristics of the negro hair. The oil or grease usually applied is not disturbing because it gives the hair a purpleviolet fluorescence between which the microsporum hair glows with a sparkling copper-green color. The grease is slightly visible in this photograph as a dull grayish halo around the patch of hair (d).

Frame (e) shows brunette hair of a white person with the normal fatty brilliance barely visible in this photograph in white light.

Photograph No. 6 is taken in ultraviolet light, but on a film with low resolving power (Eastman Kodak Orthrochromatic Par Speed Portrait film, resolving power 40 lines per mm.) The result is highly unsatisfactory. In frame (a) (Trichophyton hair) it would require a stretch of imagination to see an appreciable difference between the representation of the hair in white and ultraviolet radiation. Seborrheic scales (frame (b)) do not show any difference. In the microsporum hair (frame (c)) some diffusion along or around the hair is visible. In frames (d) and (e) only the artificial and the natural grease in the hair are visible.

Note the difference between luminographs Nos. 7 and 6 taken in the same ultraviolet light but the former on Eastman Kodak High Contrast Safety Positive film. (Resolution 70 lines to the mm.)

The Trichophyton hairs (frame (a)) appear sparkling white, the Microsporum hairs (frame (c)) are so full of spores that the hairs overradiate each other.[§] Seborrheic hair and scales (frame (c)) appear chalky white and the grease in frames (d) and (e) shows grayish-white color along the dark hair.

The only drawback in luminography is that the colors cannot be reproduced.

Kodachrome film type A is adapted for the wave lengths of the visible continuous spectrum. Despite the fact that the subjective response to the luminiscence is color, the Kodachrome film does not respond to it because the Woodlight represents a discontinuous spectrum, a narrow band of practically monochromatic radiation.

Photograph No. 7 would certainly have shown even a greater brilliancy of the hairs if they had been mounted between quartz slides which were not available.

SUMMARY

After a historical review of R. W. Wood's discovery of what is called today "black light" or "Woodlight," with its early application to clinical and research study in mycotic diseases by pioneer French Workers, an attempt is made to demonstrate its usefulness by luminography.

A case of microsporosis of the scalp is photographed in reflected ultraviolet light, using type BH-4 lamp of the G. E. Vapor Lamp Co. and Eastman Kodak High Contrast Safety Positive film on account of its high contrast and high resolving power.

Comparative photographs of fungus infected and normal hairs are presented emphasizing the necessity of using properly selected negative material of high contrast and high resolution, for photography in ultraviolet radiation.

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§ There is another reason for lack of sharp definition and crispness in luminographs. It is the focus difference of the optical system between the white and ultraviolet image. The focusing, of course, was made in white light, and no correction for the focus difference could be taken. Similar difficulty is experienced in photography, particularly in photomicrography with infra-red light, where the focus difference between the white and the infra-red image is even greater.

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CHATS WITH THE EDITOR

ON THE READING OF SCIENTIFIC PAPERS
AUDIENCE ENEMIES NUMBERS I TO VI

A few years ago a large international congress was held in one of the most beautiful cities of Europe. The ocmmittee on arrangements had planned every detail to perfection. The university buildings were new, the lecture halls ample. Each platform was provided with a two-foot clock that not only pointed out the elapsed time but also turned on a red light at eight minutes and a big flashing light at ten minutes. When the meeting started, one could say "Every prospect pleases."

Only man was vile. One hour after the opening members realized that the distinguished chairmen of the sections were not holding the speakers to the ten-minute limit so carefully stipulated in the programs. Therefore, every speaker counted on talking fifteen or twenty minutes. Of course he saved his most important slides until the end and they were shown in competition with the flashing light plus an obviously nervous chairman.

In addition, there were all the other minor and major human defects best calculated to torture an audience. Most of the speakers mumbled their words or else turned and lectured to the lantern screen. This was particularly annoying, since the papers were delivered in four different languages, each with its local variants. Most of the lantern slides were photographs of typewritten sheets crowded with data, and few speakers were content to show less than twenty. The main points were carefully concealed until the last minutes, by which time the audience had lost all interest.

This meeting was perhaps an extreme example, and in our country most of the papers are carefully prepared and carefully delivered. There are, however, enough poorly delivered papers to warrant a discussion of what may be called "audience enemies":

1. The Mumbler, who drops his voice to emphasize important points or else talks to the lantern screen instead of to the audience.

2. The Slide Crowder, who packs his slides with typewritten data and shows too many slides.

3. The Time Ignorer, who talks beyond the limit specified in the program or justified by common courtesy.

4. The Sloppy Arranger, who jumbles his material.

5. The Lean Producer, who has poor material.

6. The Grasping Discussor, who when he gets talking stays talking.

Of course there are many other ways in which a speaker may cause discomfort, but the ones that I have selected are chosen because they can be remedied either by the head of the department or by strict self-examination.

Number 1, the Mumbler, is handicapped by poor habits of speech, an incorrectly placed voice or else an inherent nervousness. In other cases bad delivery is caused by lack of consideration in a man who is more interested in excreting words than in conveying information. When he turns to the screen and talks at the chart he is paying more atttention to his own achievements than to the audience. This is particularly disastrous if he wanders away from the microphone.

Number 2, the Slide Crowder, wishes to show just as much of his data as possible and thus demonstrate his industry. He prepares many slides from typewritten sheets, because this is the easiest method. He ignores the fact that the typewriter has the worst possible type for display at a distance. Has any one ever seen such type used on advertising billboards? If he would only have his slides drawn with india ink the very labor involved would cause him to limit his material to the essentials, and these would be legible. It is a simple matter to calculate for a ten-minute paper just how many seconds each slide will be exposed on the screen and how much can be read and understood while thus exposed. Every nonessential word or figure distracts the eye from the small fraction that is essential. A good slide needs no pointer or verbal explanation.

The ideal method of competing with a slide is to employ one of the modern flashlights with a bright arrow that dances all over the screen and ceiling. There is nothing in black and white that has a chance of holding the eye when a bright arrow swoops and darts like a hornet.

Number 3, the Time Ignorer, who exceeds the limit set by the program is purely selfish or else overimpressed with the idea that his paper is much more important than the program committee had imagined. He

may have planned deliberately to go overtime but more probably did not take the trouble to rehearse his paper with a watch. If he did use a watch he forgot that it always take several minutes longer to deliver a paper from a platform than to read it in an empty room.

Number 4, the Sloppy Arranger, selects the method of presentation best calculated to confuse the audience. He may have in the back of his head the idea that he can lead up to a climax and hold the audience in breathless suspense until in the very last sentence he can prove that the venous blood of the wimpus contains only 3 milligrams of gadgetyl chloride instead of 4 milligrams. Would it not be kinder to the audience if he followed newspaper technic and gave in a headline, early in the talk, some idea as to what and wherefore?

Number 5, the Lean Producer, is only relatively lean. If he has one fact to exhibit and does it modestly he has made a contribution. If he does not recognize his paucity of material he does more harm than good. The real audience enemy is the man whose paper consists of trivia, errata, omissia, at certera; mostly et cetera.

Number 6, the Grasping Discussor, can spoil almost any meeting. If he has been invited to open the discussion he has probably prepared a nice little paper of his own with scant reference to the paper of the evening. There is another type of discussor who happens to have in his pocket some lantern slides that he would just like to show for two minutes.

In the face of all these enemies the audience itself can do but little. The chairman, however, can do a great deal. Perhaps instead of chairman he should have the title of "Sole Protector of the Audience." If he has established a reputation for keeping people within their time limits they will take the trouble to arrange their material and lantern slides and bring out their main points in a decent manner. The faults of poor delivery, poor slides and poor material are the responsibility of the head of the department. He should guard the reputation of his institution. Unfortunately, some heads of departments exhibit in their own deliveries many of the faults enumerated.

The time to start training is when a man is young. In one medical school this has been tried successfully with the fourth-year students taking their clerkship in the medical dispensary. Every Saturday morning a group of clinical clerks have gathered to hear four fifteen-minute papers delivered by members of their class. The students have been warned that the papers are limited strictly to fifteen minutes and that in rehearsal they must not take more than twelve minutes. They are advised to talk to the men in the back of the room, since these are the most

difficult to keep interested. They are taught that time spent in listening to a dull lecture, poorly delivered, is not wasted if they study the faults of the speaker and consider the methods by which they may be avoided. In a few sessions they develop a technic of delivery that is much better than the average found at scientific meetings. This allows the speakers and the audience to forget the delivery and concentrate on the subject-matter.

The man who goes overtime, uses crowded slides and mumbles his words is seldom more than 50 per cent audience enemy. If his paper comes in the middle of the session it does not affect the first half of the program, even though he talks far beyond his limit. If his slides are crowded, half of the material can be read by the front half of the room. The same front half can usually hear him, even though he mumbles his words. He would not dream of saying, "The public be damned." He just damns the rear half.

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"AUDIENCE ENEMIES'

In SCIENCE for March 13, DuBois, of Cornell University Medical School, made a vigorous plea for improving the quality of presentation of papers at scientific meetings. He described the common "audience enemies" with such clarity that no possible defense could be offered for the speakers (their number is legion) who fail to recognize that "while effective prepsentation can never take the place of able investigation, it is the indispensable means of assuring full success to any investigation."[1] However, perhaps the one most common fault indulged in by inexperienced speakers because of stage fright and continued by a large number through sheer inertia is the custom implied by the title, but omitted from the body, of Dr. DuBois's discussion, "the *reading* of scientific papers."

It is bad enough for a teacher to read verbatim to students. They at least have some reason for listening. But for a scientist to address an audience of his peers, no doubt including many of his betters, by literal reading from typed pages, is gross discourtesy. The societies themselves may partly be to blame for the prevalence of this wide-spread "audience enemy." Programs of meetings all too commonly list "papers to be

[1] Douglas Johnson, "Jour. Geomorphpology," I: 1, 64, 1938.

read" or "the following will read papers." Perhaps this time-"honored" custom should not be taken literally and that in such cases "read" really is intended to mean "present." Unfortunately, attendance at scientific meetings would indicate that many of our prominent workers take the literal interpretation and *read* their papers, word for word.

As a consequence, they address their papers and not the audience; they speak in language meant for publication, not oral presentation; they must look up and waste time when a slide appears and then rush back to the typed page after pointing to the screen, in so doing perhaps losing the place. It is virtually impossible for an investigator to make a vigorous oral presentation without looking at and deliberately focussing his attention upon his audience. Reading it is therefore ineffective and, worse, distinctly discourteous. Such a presentation automatically implies that any one could have read the manuscript, but that the investigator did so just to let the audience have a look at him. It also suggests that the speaker is willing to relate his results to his colleagues, but that they are not worth the effort required to prepare an effective oral presentation, utilizing very brief notes, if any.

Aside from papers "read by title only," we might well completely drop the word "read" from our scientific programs and practices.

JOHN B. LUCKE
Department of Geology
University of Connecticut

A seventh "audience enemy" who should be added to the six described by Dr. E. F. DuBois in SCIENCE for March 13 is the person who reads aloud from his charts or lantern slides every word or number even when "slow readers" can complete such information before the speaker is well started.

Audiences suffer, also, from speakers who discredit themselves by their slovenly pronunciation of basic scientific terms; e.g., expuriment for experiment, chimistry for chemistry, bacterawlgy for bacteriology and varus for virus.

JEAN BROADHURST
Teachers College
Columbia University

Reprinted from SCIENCE, April 10, 1942. Vol. 95, No. 2467.

News From the Trade

News from Eastman Kodak:

Eastman announces two Electric Timers — The new Kodak Electric Interval Timer has a six-inch electrically illuminated Tenite safelight dial, Equivalent to a Series III Wratten Safelight. The timer is marked off into 60 cycle, 105-120 volts, AC outlet, this new timer will provide dependably accurate timing for film and paper development. When the push button control on the top of the timer case is pressed, a white hand on the dial begins to mark off the half minutes. After the chosen interval has been reached, a buzzer sounds and the white hand returns to zero automatically. The buzzer will continue to sound until it is turned off by pressing another push button on the timer. The interval indicating hand need not be reset if the same interval is to be repeated. The timer lists at $12.50. The new 90-second Kodak Electric Control Timer will be welcomed by picture takers who do their own printing and make their own enlargements. It is designed to act as an automatic electrical time switch for prints and enlargements using lamps of 1000 watts or less. It can be preset for exposures ranging from one second to 100 seconds, then when the desired interval is reached, it shuts off the printing lamp automatically. Attractive in appearance and well built, the Kodak Electric Control Timer has a six-inch, iluminated Tenite safelight dial, permitting convenient operation of the controls at any location in the darkroom. A push button on the top of the case starts the time interval. When the number of seconds for which the lamp is set elapses, it is turned off automatically and the sweep hand returns to zero. The same interval may be repeated as many times as desired without resetting the interval indicating hand. The price of the Kodak Electric Control Timer is $15.50 list.

Kodak Lens Manual Announced — This new Kodak Data Book gives informative data, some of it theoretical, most of it practical, on Kodak lens properties and factors affecting lens performance for black-and-white color photography. It also treats with the uses and applications of Kodak supplementary lenses. Rangefinder theory and practice are discussed in this new manual, and still another section is devoted to between-the-lens and focal plane shutters, shutter efficiency, and flashbulb snapshots. No less than thirty-six various depth of field and field size tables are included. Some of them, for example those dealing with Cine-Kodak Eight- and Sixteen mm. lenses, have never before been shown in any other generally available publication. A small part of the

book is devoted to new advances in the field of lens manufacture and how a lens is made. The Kodak Lens Manual will make a favorable and authoritative addition to every photographer's working library. It is priced at 35 cents per copy.

Kodacolor and Indoor Kodachrome Exposure Guides announced — Camera fans both old and young in experience will be happy to hear that two new additions have just been made to the long and respected list of Kodak Handy Pocket Exposure Calculators. One of these, the Kodacolor Exposure Guide, gives full data for determining the correct exposure under various daylight conditions for the sensational new Kodacolor Roll Film. The other, the Kodachrome Indoor Guide, will enable many a puzzled photographer to instantly and accurately determine correct indoor exposure for both flash and flood lighting when using Kodachrome Type A Film. Following the familiar Kodaguide dial-and-arrow system of converting essential facts into correct exposure recommendations, both of the new guides are very simple to operate. They are priced at 10 cents each.

Direct Autopositive printing paper announced by Kodak — A direct method for making black-and-white enlargements or contact prints from Kodachromes, lantern slides, and other forms of transparencies, has just been introduced with the announcement of Kodak Autopositive Paper. A direct reversal paper, Kodak Autopositive Paper does not produce a negative result when exposed, but gives a brilliant, full-ton, black-and-white positive print. Kodak Autopositive Paper is available in two sizes: 3¼ x 4½ inches and 5 x 7 inches. It is orthochromatic and must be handled under a Series I safelight, but this new paper is characterized by ample speed, a rich black tone, and a simple method of processing. In fact the processing of Kodak Autopositive Paper is similar to that for making ordinary black-and -white prints. Borders obtained on prints or enlargements, however, will be black unless they are flashed before the prints are processed. Not only will Kodak Autopositive Paper enable amateur photographers to easily make excellent black-and-white prints or enlargements of their full-color transparencies, but with the paper it will now be possible to make good record prints from Kodachrome transparencies which, due to poor lighting or faulty exposure, may be imperfect in color balance or density. Two-dozen-sheet packages of 3¼ x 4½-inch paper retail at 42 cents, and one-dozen-sheet packages of 5 x 7-inch paper also retail at 42 cents.

News from Agfa Ansco:

To commemorate its 100th anniversary this year, Agfa Ansco has published and is making available free copies of a profusely illustrated centennial booklet which graphically presents the story of the origin and development of America's oldest photographic manufacturer. Prepared in chronological form, the Centennial Book links the progress of Agfa Ansco with the advancement of photography in the United States throughout the past one hundred years, selecting for special emphasis the most outstanding historical dates. The significance of each date mentioned is discussed in a concise and interesting manner while the numerous illustrations contribute greatly to the effectiveness of the booklet. Of particular interest to photographers will be the story of Edward Anthony, founder of the company that is now Agfa Ansco, and his associates, who greatly influenced the progress of American photography from its infancy. Anthony established the precedent for which Agfa Ansco is famous today, in providing an impressive list of photographic "firsts"; the first pictures ever used by any government; the first Washington, D. C., portrait studio; the first photo prize contest; and many others. This well-presented booklet will be a welcome addition to the library of everyone interested in photography. Complimentary copies of the Centennial Book may be obtained by addressing requests directly to the Service Department, Agfa Ansco, Binghamton, New York.

News from Wabash:

Important changes in Blackout bulb specifications are announced by the Wabash Appliance Corporation, Brooklyn, N. Y., whose silver-lined Blackout bulb placed on the market in early January was put through exhaustive blackout tests in actual city-wide blackouts in practically every State. Specification changes are based on the results of these tests, as well as on various officials recommendations. The most important specification change is in color of light from blue and red to the deep orange recommended by the Office of Civilian Defense. Other changes are in size which is smaller, in reduced current consumption to 15 watts, in elimination of the former built-in reflector, and in the improved type of heavy black silicate coating to prevent light leakage. The deep orange light that the new unit provides, is said to be ample to permit room occupants to see each other plainly, as well as furniture, doors and windows. The bulb will fit any huosehold socket, and will list at 45c.

Bulletin No. 301 on "Flashing Kodacolor" lists data and exposure tables on the flashing of Kodacolor with one bulb mounted at the cam-

era, or two bulbs flashed in tandem lighting. The daylight blue flash only is recommended, as this has the higher 6,000° Kelvin temperature coming nearest to the ideal lighting conditions of bright summer sunshine. Write for your free copy to Wabash Photolamp Corporation, Brooklyn, N. Y.

News from Bell and Howell:

A series of six reels of 16 mm. motion pictures have been produced for practical instruction in first aid. The film follows the general line of presentation that is used in the official Red Cross handbook, which makes it a practical visual aid in the teaching of this timely subject. The six reels contain a general introduction to the course, bleeding, resuscitation and shock, bandaging for wounds and burns, and the emergency treatment of fractures, and transportation of the injured. Silent versions of the series of reels are available in black-and-white and color for immediate rental or purchase. Also available are 8 mm. black-and-white reels. A sound version is being prepared. The Bell and Howell Filmsound Library and its dealer representatives are the exclusive distributors.

F. R. HARDING
Children's Hospital
Boston, Mass.

TO OUR MEMBERS

Our membership year ends June 30. Dues for 1942-43 are payable in advance, and you will receive a renewal notice early in June. All those who are sending in renewals can help us greatly by sending them promptly. Do you usually wait and renew at the Convention? Turn over a new leaf this year and renew this spring instead. This will save us the time and expense of sending you a second notice, and will ensure your uninterrupted subscription to the JOURNAL. If you have not renewed by the time the first issue of the new volume comes out, it cannot be sent to you at our reduced postal rate. In other words, the longer you wait the less of your dues goes into the Association Treasury. And this year of all years, we want all available funds for the work that lies ahead!

Association News

PHOTOGRAPHY IN THE 93RD SESSION OF THE A. M. A.

It is interesting to note that six photographic exhibits are listed in the Atlantic City Number of the A.M.A. Journal. This surely represents a new high in the emphasis of photography in medicine. The use of still and motion pictures as adjuncts and illustrations of medical subjects was wide-spread last year. But in the six booths mentioned above photography is not merely the means, but the chief end of the exhibit.

The B.P.A. show will be the only one covering medical photography in general. We stress the fact that our complete descriptions of techniques will be available and that our booth will be attended at all times by a scientific photographer qualified to discuss problems of medical photography. If circumstances permit us to continue these annual shows, we hope to become known as a center of information to which doctors can bring questions on their individual problems.

The other five shows are specialized in various fields. One is listed as *Surgical Photography,* exhibited by one of our members, Dr. John Fallon, Worcester, Mass., and two associates. It will show methods, apparatus and results in the still photography of lesions, operative fields and specimens.

Dr. Paul Holinger, of the University of Illinois College of Medicine, also a B.P.A. member, is contributing an exhibit on Photography of the *Larynx, Tracheobronchial Tree and Esophagus.* The equipment devised to take motion and still pictures of these regions will be shown, with charts illustrating the technic of photography through the laryngoscope, bronchoscope and esophagoscope.

Lowrain E. McCrea, of the Temple University Medical School. is contributing an exhibit on *Cystoscopic Photography — Its Application in the Practice of Urology.* He will show transparencies in color of sagittal sections of the human body, showing the introduction of the cystoscope and the application of the cystoscopic camera, and an exhibit of pictures taken with this equipment.

Thomas N. Horan and C. Graham Eddy (Director B.P.A.), Eloise and Harper Hospitals, Detroit, Michigan, are showing *Laparoscopy: Intra-Abdominal Photography in Color* including an historical review of the development of the equipment; demonstration of a newly designed trochar, lamp-housing and spring arrangement for taking photographs in color within the abdomen, and special high-intensity lamps; also an

exhibit of wash-off relief prints of intra-abdominal photographs in color and Kotavachrome enlargements showing the technique of this type of photography.

Henry A. Rafsky, Lenox Hill and Beth Israel Hospitals, New York is holding an exhibit on *Intragastric Photography in Conjunction with Gastroscopy.* The method employed in taking the gastrophotographs is illustrated, as are the gastrophotographic studies made in a series of patients who presented diagnostic and therapeutic problems.

PROPOSED AMENDMENT TO THE B.P.A. CONSTITUTION

Two Types of Sustaining Memberships

At present our constitution provides for one type of Sustaining member only, in Article III on Membership, as follows:

> "Membership shall be of three classes, namely, Active, Association and Honorary.
>
> Section 1. Active — Anyone whose professional duties include photography of biologic subjects shall be eligible to Active Membership and shall be entitled to all the privileges of the Association.
>
> "Section 2. Associate — All others who are interested in such photography shall be eligible for Associate Membership. They shall have all the privileges of the Association except to vote and hold office.
>
> "The dues shall be $3.00 per year, July 1 to June 30, in advance. In both classes the member may be rated as a Sustaining Member by the payment of $10.00 per year dues. Such a member is to have the right of returning to regular membership without prejudice or obligation."

By a vote of the Board of Directors it was resolved to propose an amendment at the 1942 Business Meeting to affect only the paragraph beginning "The dues shall be," etc., which should be amended to read:

> "The dues shall be $3.00 per year, July 1 to June 30, in advance. In both classes (Active and Associate) the member may be rated as a Sustaining Member by the payment of $5.00 or $10.00 per year dues. Such a member is to have the right of returning to regular membership without prejudice or obligation."

The Directors felt that by having a $5.00 as well as a $10.00 Sustaining Membership fee we would make it possible for more of our

members who wish to contribute toward the support of the Association to join or renew in the sustaining group. A $5.00 Sustaining Member, although he pays only $2.00 more than the regular fee, would put more into the Association's treasury than two regular members. This is because he requires only one copy of the JOURNAL and so a greater proportion of his dues can be spent for other Association work. For the same reason a $10.00 Sustaining Member contributes more available cash than *six* regular members. We by no means wish the new class of Sustaining member to discourage our $10.00 members, who are among the Association's most valuable assets. But we know of several members who would like to contribute something toward the Association's work but who cannot enter in the present Sustaining group. The Directors felt if the members voted favorably on establishing a $5.00 Sustaining group as well as a $10.00 one, no differentiation should be made between the two groups in the list of Sustaining Members when appearing in the JOURNAL.

THE 1942 SALON

This may seem somewhat far in advance to talk about the 1942 Salon, but as this may be the last copy of the JOURNAL reaching you before the Annual Meeting, a brief review should be timely.

First of all, the general consensus of opinion is that the Salon is assuming added importance each year, not only to acquaint the members with the work being done in the field, but also because of the publicity value in obtaining new members. In most cities where we have held conventions, the local press have been fairly generous in their write-ups and there is no doubt that the Salon was far more effective than words in impressing those outside of the organization. Clinicians, biologists, research workers, etc., are all prospective members and it seems logical to assume that the Salon constitutes one of the most effective means of putting across the story of the BPA.

Once again we make a plea for prints; X-rays, Kodachrome transparencies, in fact, any illustrative material. In the past we have had a fair selection of Kodachrome transparencies, but the number of prints has not been particularly encouraging. Last year we had only 124 submitted and surely in an organization the size of the BPA we can do better than that in 1942. Possibly you think it is a bit of trouble to prepare prints just for a three-day Salon. Bear in mind that your prints may be particularly interesting to some other member, and it is only by

having a Salon fully representative of all phases of scientific photography that we can visually demonstrate the work being done in the field.

Please make a note right now and a firm determination to send in *at least* four prints. Don't take the attitude that no one would be interested in some particular subject on which you have been working. For all you know, these may be the very subjects on which other members would like to get further information.

As to specifications, all we ask is that pictures be sent unframed and, of course, standard 16 x 20 mounts are preferable, although not obligatory.

You will be advised in a later communication just where the prints are to be sent and we must ask that all prints be sent so as to arrive in the hands of the committee at least two days prior to the opening of the convention. Last year many members brought their prints with them, and we think you will admit this is pretty tough on the Salon Committee. We want to have the Salon all arranged and finished by the time the convention opens and although we are always glad to see good material, even at the last minute, it causes considerable inconvenience and in some cases it is almost impossible to find a place for them.

We are going to ask your cooperation in carrying out one particular request this year, and that is attaching a description (if one is necessary) to the print. At both Milwaukee and Buffalo, reviewers from the press asked for descriptions of some of the work and that caused no little trouble. We found it quite a problem, sometimes, to locate the exhibitor; in some cases these descriptions were impossible to get as the exhibitor was not at the convention. If you could have this description typewritten on a piece of white paper and just attach by one corner to either the face or the back of the mount, we could then arrange the Salon with the description under each print. Just picture how much more interesting the Salon would be to you, if, in studying the pictures, you could also get the description.

NATHAN S. HORTON
1005 McGill Building
Montreal, Canada

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1942 Salon	Nathan S. Horton 1005 McGill Building Montreal, Canada

THE JOURNAL OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION

Information for Contributors and Subscribers

Manuscripts should be sent to Leo C. Massopust, Editor, Marquette University School of Medicine, Milwaukee, Wisconsin. They should be typed and double spaced; only the original copy should be *submitted.* Original drawings not photographs of drawings should accompany manuscript. All illustrations should be marked with the author's name and address. General references to literature should appear at the end of the manuscript. References to literature cited should appear as footnotes.

All articles published in this JOURNAL must be contributed to it exclusively. If subsequently printed elsewhere, due credit must be given as to the source of original publication.

Neither the Editor, the Biological Photographic Association nor the publishers accept responsibility for the opinions of contributors, nor are they responsible for other than editorial statements.

Review of Books: Books and monographs will be reviewed according to their merits and the space available. Send books to Leo C. Massopust, Editor, Marquette University School of Medicine, Milwaukee, Wisconsin.

All matters concerning the Association should be sent to Miss Anne Shiras, Secretary, University Office, Magee Hospital, Pittsburgh, Pa.

Correspondence concerning subscriptions and other business matters should be sent to Leo C. Massopust, Editor, Marquette University School of Medicine, Milwaukee, Wisconsin.

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New subscriptions and renewals are entered to begin with the first issue of the current volume. Should any issue of the current volume be out of print at the time the subscription order is received, the pro-rata value of such numbers will be credited to the next volume, and the renewal invoice therefore adjusted accordingly.

Subscriptions should be renewed promptly to avoid a break in your series. The publishers cannot guarantee to supply back issues on belated renewals.

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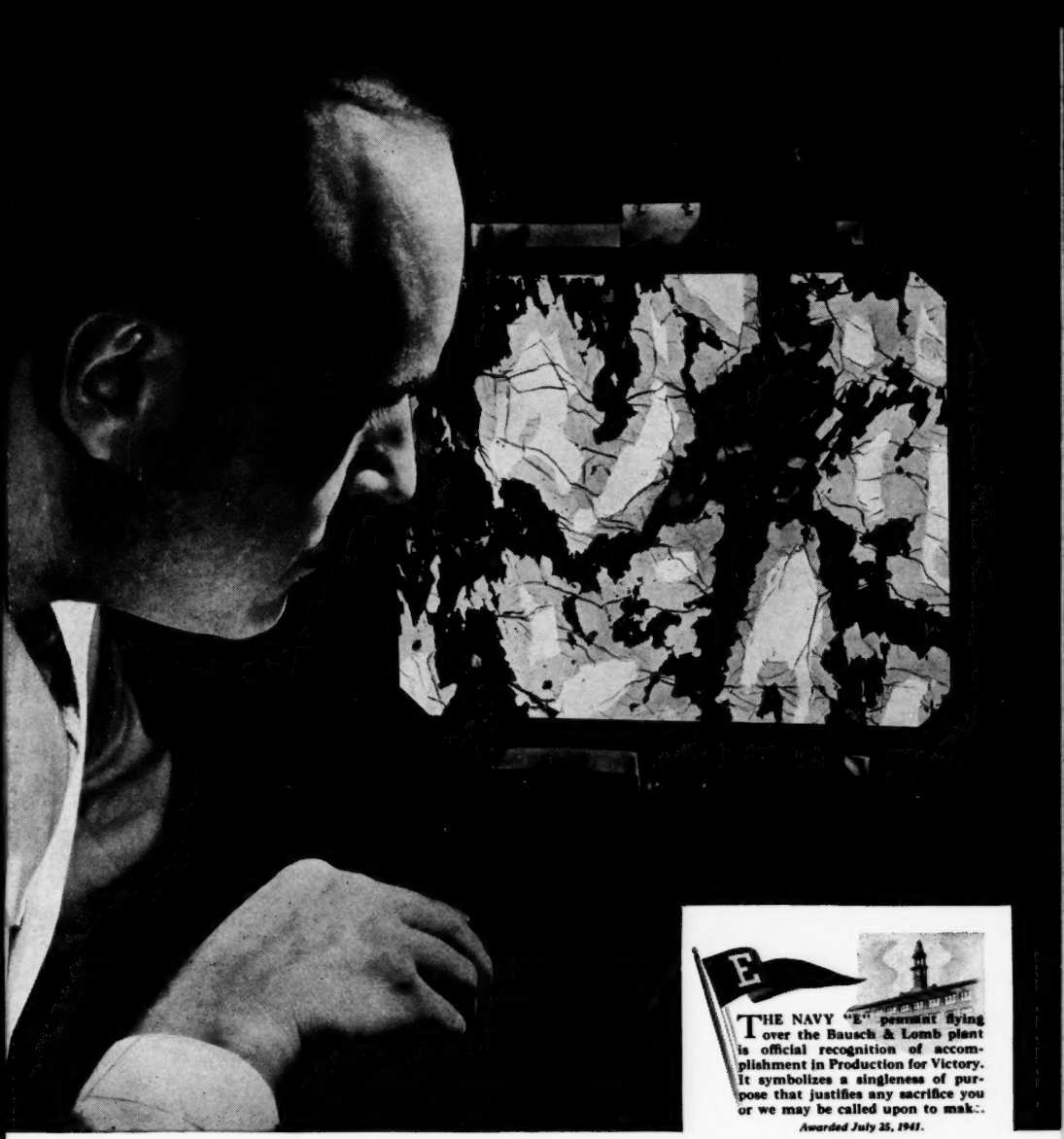

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KODAK
announces 2 new plates

Eastman Tri-X Panchromatic, Type B, AH Panchromatic . . . extremely high speed . . . similar to Tri-X Film, except that color sensitivity is Type B panchromatic instead of Type C. Ideal for color-separation negatives from Kodachromes . . . for low-contrast correcting masks . . . for other applications requiring high speed and low contrast.

Eastman Tri-X Panchromatic, Type B, Matte AH Plate is identical to Tri-X Plate, Type B, mentioned above, except for a matting agent in the emulsion. This gives just enough "tooth" to permit retouching without the use of retouching fluid.

KODAK
offers for your convenience

The two tables below are designed to minimize the inconvenience caused by the discontinuance of certain Kodak films and plates because of conditions resulting from the war. As you will note, to take the place of each discontinued film or plate there remains a similar or even better Kodak material. (Discontinued items will be supplied on order only as long as present stocks last.)

DISCONTINUED FILM	SIMILAR FILM
Par Speed Portrait	Super Speed Ortho Portrait AH
Commercial	Commercial AH
Commercial Matte	Commercial Matte AH
Process	Contrast Process Ortho AH
Process AH	Contrast Process Ortho AH
Commercial Panchromatic	Panatomic-X AH
Super Sensitive Panchromatic AH	Tri-X Panchromatic AH
Panchro-Press AH	Super Panchro-Press AH
Regular (N.C.) for Cirkut Cameras	Verichrome for Cirkut Cameras
Plus-X Pan Nos. 51 and 53 for Graflex Roll Holders	Super-XX or Verichrome for Graflex Roll Holders
Panatomic-X Nos. 51 and 53 for Graflex Roll Holders	Super-XX or Verichrome for Graflex Roll Holders
Kodatron Panchromatic AH	Super Panchro-Press AH

DISCONTINUED PLATE	SIMILAR PLATE
Universal	Eastman 40 AH
SC Ortho	Polychrome AH
DC Ortho	Polychrome AH or Commercial AH
Post Card	Commercial AH
33 Gravure AH	Eastman 33 AH
Panchromatic	Panchromatic AH
Tricolor Panchromatic AH	Tri-X Panchromatic, Type B, AH
Tricolor Matte Panchromatic AH	Tri-X Panchromatic, Type B, Matte AH
Eastman 33	Eastman 33 AH
Lantern Slide Plate, Soft	Lantern Slide Plate, Medium AH

See your local Kodak dealer . . . or write for "Price List of Kodak Films, Plates, Paper and Chemical Preparations," in which size and further information are listed.

EASTMAN KODAK COMPANY, Rochester, N. Y